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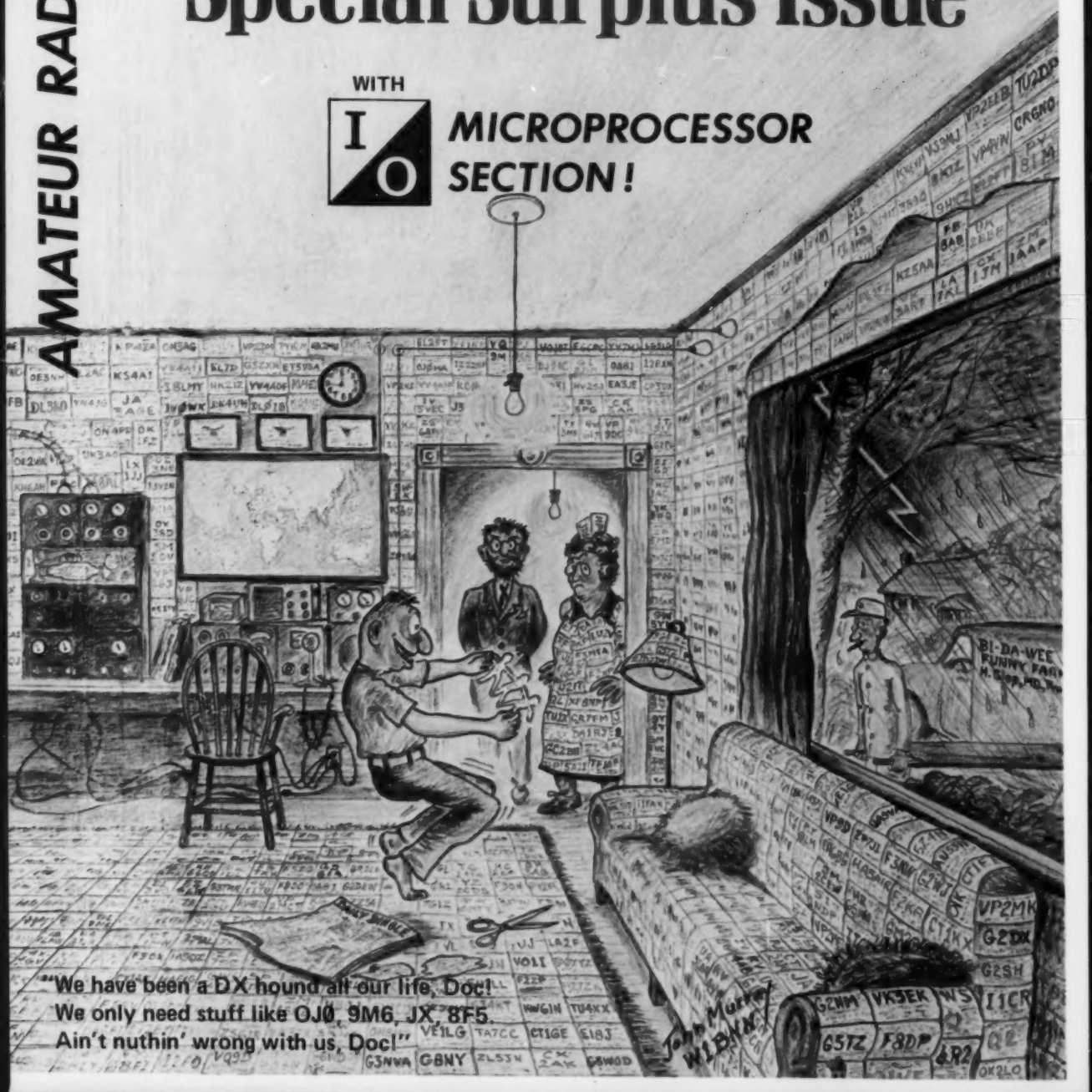
73

AMATEUR RADIO

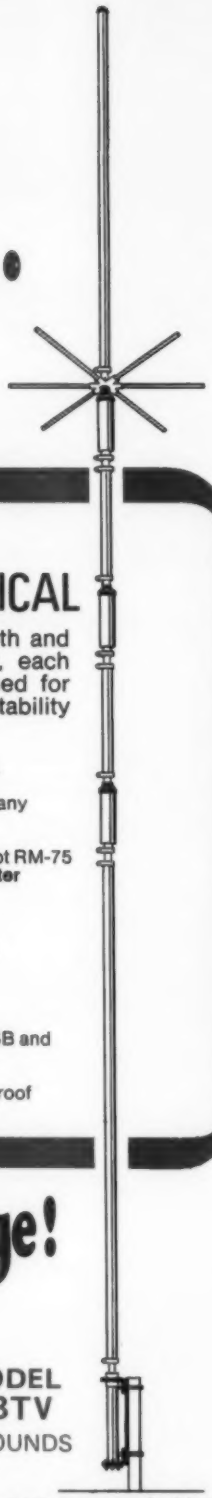
Special Surplus Issue

WITH

I/O MICROPROCESSOR SECTION!


"We have been a DX hound all our life, Doc!
We only need stuff like OJØ, 9M6, JX, 8F5.
Ain't nuthin' wrong with us, Doc!"
BI-DA-WEE FUNNY FARM
John Murray W1BVN

if the 4-BTV weighs 39% more... what do others leave out?



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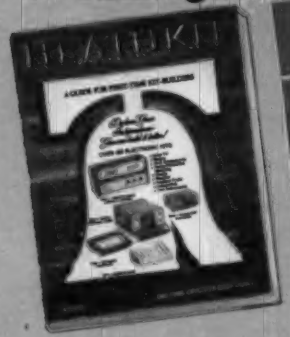

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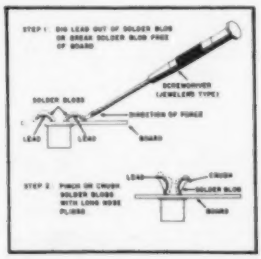

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73 staff

EDITOR/PUBLISHER
Wayne Green W2NSD/1

GENERAL MANAGER
Biff Mahoney

MANAGING EDITOR
John C. Burnett

ASSISTANT EDITOR
Susan G. Philbrick

ASSOCIATE EDITORS
Alex Barvicks WB4RVH
Fred R. Goldstein WA1WDS

PRODUCTION MANAGER
Lynn Panciera-Fraser

ART DEPARTMENT
Nancy Estle
Peri Mahoney
Bob Sawyer

PRINTER
Brent Lawler

PHOTOGRAPHY
Bill Heydolph

TYPESETTING
Barbara J. Latti

ADVERTISING
Bill Edwards WB6BED/1
Nancy Cluff

COMPTROLLER
Knud E. M. Keller KV4GG/1

CIRCULATION
Barbara Block
Dorothy Gibson
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INVENTORY CONTROL
Kim Johansson
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PLANT MAINTENANCE
Bill Barry
Elaine Mercier

ASSOCIATES
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E. H. Barnett WBØIIX
Schley Cox WB9LHO
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Terry Fox WB4JFI
W. Sanger Green
Dave Ingram K4TWJ
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Bill Turner WAØABI

DRAFTING
Bill Morello
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T. M. Graham Jr. WBFKW

...de W2NSD/1

EDITORIAL BY WAYNE GREEN

SUE THE BASTARDS

Though we try to put as good a face on it as we can, the fact is that every now and then we have our little trouble spots within Amateur Radio. Alas. When we run up against someone who is being unreasonable (defined frequently as not agreeing with me), we get mad and try to get someone else to do something. We may try to bring the FCC into our problem . . . or even lawyers . . .

May I remind those who are caught up in a repeater war, fighting a pirate repeater, or trying to keep an organized net going through deliberate interference, that though it is difficult not to lose perspective, that these are the times when you should reference the amateur regulations . . . the part where it says that we are largely self-regulating. You are now in a spot where self-regulating is called for and you haven't figured out how to regulate the SOB who is making life miserable for you.

Further reminder . . . this is the time when you will find out who has the most brains. You are in a fix and you need to be able to outsmart someone . . . the FCC is no answer to anything . . . neither is a lawsuit. If you bring the Candy Company in you could easily end up with a bunch of rules which you and several generations of hams will hate. And if you bring in the lawyers you could end up with laws you won't like. Remember that when cases get tried in court they form legal precedents, and once set, they are very difficult to upset.

What I'm saying is that there are a lot of very good reasons for Amateur Radio to stay self-policing. Any time we can't seem to make it stick by ordinary peer pressure, we ought to call a council of amateurs and see if someone can come up with a good proposal. It may mean a mass visit to an offending amateur to try and reason with him. If that doesn't work, then either sterner measures or else more brainstorms are needed . . . but, please . . . keep the lawyers and FCC out of our problems.

CB GROWTH

All those beautiful stories in the newspapers about CB have had an impact, as is obvious by even more articles appearing in the papers. The FCC reports that while it took sixteen years for the first million CB licenses to be issued, the second million took eight months, the third million three months . . . got the picture?

Now let's suppose that our national organization of Radio Amateurs got busy and set up a PR firm to start getting articles on ham activities in the papers and magazines. The media is the message these days, as all of us know, and newspaper articles obviously make an enormous difference. We wouldn't get millions of hams, but we certainly would see a big upswing in interest . . . clubs would find people clamoring to get into their license study classes and we would start having enough amateurs to get activity on some of our presently vacant bands such as 50 and 220 MHz. Let's put 28 MHz in there too.

What would such a PR effort cost these days? Maybe $100,000 a year . . . about 35¢ per amateur . . . about 5% of said national organization's annual budget . . . and, if they really have the 100,000 members they claim, that would be one buck per, cheap enough. If I mention it to them they'll just get mad, so it's up to you to bring it up. Don't mention me.

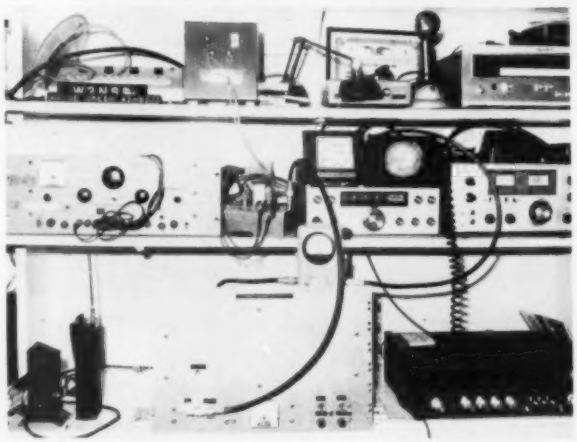
OSCARING

Even though I'm only getting about 20 Watts or so into the 432 MHz antenna, I've been getting a lot of 5x9 reports, so it definitely works. The main frustration about working mode B of Oscar 7 is that there are so few American stations active. Some satellite passes see the 50 kHz segment virtually empty with me in there loud and clear calling CQ, plus maybe one or two CW stations doing the same. W2BLV and W2BXA, should they shut down, would just about empty Oscar on many runs.

On the European passes it is a different story . . . QRM all over the place. I suspect there are more French stations on Oscar than U.S. I've worked 15 countries as of now and have several more to go that I've heard coming through.

Here is my setup . . . it doesn't look like much. It starts out on transmit with the little Ten Tec Argonaut. That feeds on 28 MHz into a Carmichael upconverter with output on 432 MHz. That feeds into a home made 4CX250 amplifier with about 60 Watts emerging . . . that big thing on the bottom shelf . . . used to be the amplifier for WR1ABV on 450 MHz . . . and probably will again one of these days. That goes by coaxial resistor up to an 11 element circularly polarized antenna which stops working when it rains. The antenna controls are on top of the Argonaut, azimuth and elevation. A Vanguard converter is mounted up at the two meter circularly polarized antenna and that feeds down to the Yaesu FTDx-560. A little Sony tape recorder catches the results. The great big power supply on the left is for the upconverter, a tube affair, and feeds it a mundane 250 volts at about 75 mA. The VHF Engineering power supply on the top shelf runs the Argonaut and the Vanguard converter.

I recommend that you do a little work and get active on Oscar . . . it is a ball and we could use another few dozen good signals on it. Some of the



When you get tired of compromises...

TS-700A Specifications

TRANSMIT/RECEIVE FREQUENCY RANGE: 144-148 MHz
MODE: SSB, FM, CW, AM
RF OUTPUT: CW, FM: more than 10W output. AM: more than 3W output. SSB: more than 20W DC input.
ANTENNA IMPEDANCE: 50Ω (unbalanced)
CARRIER SUPPRESSION: Better than 40 dB
SIDE-BAND SUPPRESSION: Better than 40 dB
SPURIOUS RADIATION: Less than −60 db
MAX. FREQUENCY DEVIATION (FM): ±5 kHz
REPEATER FREQUENCY SHIFT WIDTH: 600 kHz
TONE BURST TIME: 0.5-1.0 sec.
MODULATION: Balanced modulation for SSB. Variable reactance frequency shift for FM. Low power modulation for AM.
MICROPHONE: Dynamic microphone, 500Ω
AUDIO FREQUENCY RESPONSE: 400-2600 Hz, within −9 db
RECEIVING SYSTEM: SSB, CW, AM: Single-superheterodyne. FM: Double-superheterodyne.
INTERMEDIATE FREQUENCY: SSB, CW, AM: 10.7 MHz. FM: 1st IF: ... 10.7 MHz. 2nd IF: ... 455 kHz.
RECEIVING SENSITIVITY: SSB, CW: S/N = 10 dB or better at 0.25μV. 20 dB noise quieting = Less than 0.4μV. AM: S/N = 10 dB or better at 1μV.
IMAGE RATIO: Better than 60 dB
IF REJECTION: Better than 60dB
PASS-BANDWIDTH: SSB, CW, AM: More than 2.4 kHz at −6 dB. FM: More than 12 kHz at −6 dB.
RECEIVER SELECTIVITY: SSB, CW, AM: Less than 4.8 kHz at −60 dB. FM: Less than 24 kHz at −60 dB.
SQUELCH SENSITIVITY: 0.25μV
AUDIO OUTPUT: More than 2W at 8Ω load (10% distortion)
RECEIVER LOAD IMPEDANCE: 8Ω
FREQUENCY STABILITY: Within ±2 kHz during one hour after one minute of warm-up, and within 150 Hz during any 30 minute period thereafter.
POWER CONSUMPTION: Transmit mode: 95W (AC 120/220V), 4A (DC 13.8V), max. Receive mode (no signal): 45W (AC 120/220V), 0.8A (DC 13.8V).
POWER REQUIREMENTS: AC 120/220V, 50/60 Hz. DC 12-16V (13.8V as reference).
DIMENSIONS: 278 (W) x 124 (H) x 320 (D) mm
WEIGHT: 11 kg
SUGGESTED PRICE: $700.00

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Kenwood... pacesetter in amateur radio

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116 East Alondra / Gardena, California 90248

chaps are working out fine with as little as two and three Watts. It isn't easy to get on mode B, but then being difficult is one of the things that makes it fun.

Amsat has announced that G3IOR has earned the Oscar ten district award, having worked all ten U.S. call districts via Oscar. One other interesting news event via Oscar . . . VE2BYG and WB4BWK have linked their microprocessors up via Oscar! Several fellows are working on this project so we can look for a lot more of that to come.

MODE B PROBLEM

Amsat has passed the word that a few of the mode B users of Oscar 7 have been running too much power and it has been draining the batteries. Listening to some of the stations coming through leaves little doubt as to which ops are doing the damage . . . a few signals stand out with rock crushing clarity and you know those fellows are not running any 100 Watts.

When it isn't raining I find that I have a fine signal through Oscar, with most reports running 5x8, and I'm pushing about 20 Watts into the antenna. I can barely hear my CW signal when the antenna is wet.

Amsat suggests you tactfully suggest some lowering of power when you contact one of the superpower boys.

ELIMINATE A HURDLE

Considering the excessive delays in getting license applications processed, an additional hurdle just isn't all that needed. In this case, it is the failure of many applicants through no real fault of their own . . . but due to their study guides being behind the times or not complete enough.

A nice letter from WN5OIC claims that he and his 14 year old son failed the General Class exams because only about two-thirds of the exam material had been covered in their study guides . . . one put out by the ARRL and the other by another well known publisher (not *73*). They now have the *73* General Class Study Guide and they should have no further problems.

If you know of anyone working for a ham ticket, you really should acquaint them with the *73* series of books which are, as far as I know, the *only* study guides which cover all of the technical material you'll find in the exams. Some of the other books are so far out of date that it is incredible. One was written by a ham who has been dead for many years, and even though it is hopelessly outdated the publisher continues to push it. One, written in the 50's, was reprinted again in 1975 and is being sold today through a ham magazine that deserves to remain nameless.

Look up the license study series in the Radio Bookshop ad. Clubs can order in quantity and get a nice little discount if they write to the Bookshop. Orders should be for at least 10 books in any assortment. This helps anyone who is taking a club-given study course to get the books he really needs . . . and the code tapes.

MOBILE ALL BANDS?

Chuck Martin WA1KPS, the chap who runs Tufts Radio . . . New England's largest ham distributor . . . stopped by *73* the other day to see how the Oscar mode B work was coming (we're using his 432 MHz amplifier). He had brought along a long two meter beam to take to the top of the nearby mountain and run checks on how much extra Oscar time and distance operating from another thousand or so feet would give.

The Tufts truck is a car thief's delight, bristling with antennas. But when Chuck calls out "Breaker One Nine" he means the 19-79 pirate repeater, not CB. Chuck is mobile on all ham bands from 1.8 MHz up through 450 MHz. Can anyone beat that?

The Oscar tests? It turns out that Oscar can be heard over two minutes earlier from the mountain top toward Europe than down in Peterborough. There wasn't as much difference to the west, where the mountain was not blocking reception.

RFI BRAINSTORM

While a few amateurs have been pushing hard to get the RFI bill into law, a letter from Ted Chernin KH6GI on the subject made a lot of sense to me. He suggests that here we go again trying to get the government to do something that we could do ourselves . . . without fighting for any bills or waiting for the government to set up a $500 million agency to look into RFI cases.

Ted says why not get busy right now and either instead of or in addition to letters to your congressmen, write to the consumer magazines and ask that they include RFI susceptibility as one of their measurements on new electronic equipment such as television, hi-fi, and such.

Further, when you run into an RFI problem, drop a note to your favorite ham rag and ask them to pass the word. If you are able to cure said misery, pass the word (same route) on how you did it. Also, write to the manufacturer.

You might just make sure that dealers are not ignorant about RFI. You'll find that most of them will try real hard to blame the amateur or the CBer if there is interference, not the hi-fi set. He'll tell you just to write to the FCC and get the ham put off the air. Instead of hitting the guy, grit your teeth and explain about how these things are.

Consumer Reports, Box 1111, Mt.Vernon NY 10550, if you feel like

Continued on page 12

LETTERS

ou goons don't ever proofr
l
b
bunch of rocks
you ignored my comments in
I insist that you print ev

UP THE CREEK

Boy are you guys up the creek! Me an' my good buddy the Duster were mobiling easy up I-75 when we saw the biggest cotton-pickin' mobile antenna ahead ever seen! Well, we tried to modulate with him on 19 but he wouldn't copy.

Then Duster noticed a decal on his bumper that said, "Hang it up, CB! – Be a ham!!!"

Well we-all got rightly upset at him so we followed him into a diner along the way. We confronted him and he explained what a mess CB is and how he started reading *73* and before he knew it he had sold all his CB stuff to some trucker from Ohio and bought all kinds of amateur equipment. Duster an' I went over to a radio store and asked about classes at the local high school . . . and what do you know??? Now we're selling all of our CB things!!!

Amateur radio is really easy; I can't remember when I *didn't* know most of the questions on the Novice test! The code's a bit tricky but no real problem there.

What I would really like to know, is, how come I don't talk funny anymore?

Paul Valko
Sterling Hgts MI

HEARTBREAKER?

I have a problem which *73* may be able to help me with.

October 23, 1975 I had a Kordis heart pacemaker installed or implanted. The doctors told me that I could not use a power lawnmower, electric razor or any power tools which have a magnetic field revolving.

Since the pacemaker can be controlled magnetically and also electronically, it becomes evident that the antenna which runs into my heart could pick up harmonic frequencies which would put the pacemaker in a passive mode.

I have written the Kordis Company and a spokesman for the company called me on the phone from North Carolina and gave me some of the things I could not use, but he had some reservations about harmonic frequencies.

What I need to know is whether *73 Magazine* could ask its readers if any of the amateurs who read it could give me the names of active amateurs who have pacemakers and whether they have any deleterious effects from radio.

One of the things which the Kordis people told me that would deactivate the pacemaker was a pulsed signal.

Since I work mostly CW, I am not

active at the present time. I do not expect any person to stick his neck out, but would appreciate the names of persons I can contact by phone who qualify as recipients of pacemakers and are amateur operators now active.

Richard M. M. Hudson K8YYP
P.O. Box 284
Geneva OH

UNBELIEVABLY GOOD

The service from S.D. Sales is unbelievably good!!!

A clock kit ordered on 22 November 1975 arrived here on the 28th, and was operating that evening. Further, when I wrote S.D. Sales that one segment of one of the 7-segment displays was weak, they sent me three (!) FND-70 LED replacements. Free!

Amateurs have always demanded high quality components and fast service. What is unusual today, however, is to find a company which provides both. S.D. Sales is such a company!

Theodore J. Cohen W4UMF
Alexandria VA

GRAND OPENING

I would like to report to you guys on the 2 meter opening which came through this area on the weekend of Dec. 6 and Dec. 7.

This opening lasted about 48 hours, working through the Mena, Arkansas Repeater, which is on .19-.79. The repeater's call is WR5AEM. It is located at the top of Rich Mountain at an altitude of about 3000 feet above sea level. It has an operating output power of about 25 Watts.

On this weekend there were 14 states working through this repeater. They were the following: Arkansas, Louisiana, Mississippi, Alabama, Kentucky, Tennessee, Indiana, Illinois, Iowa, Missouri, Kansas, Nebraska, Oklahoma and Texas.

We would appreciate you making the public aware of this opening.

Howard Holmes WB5NWV
De Queen AR

NO

I propose a standard color-coding system for mobile antennas so that one mobiler could quickly visually tell what band another mobiler was operating at that given time: 80 – grey/black; 40 – yellow/black; 20 – red/black; 15 – brown/green; 28 – red/grey (standard color codes).

The two colors could be colored tape (or paint) around a loading coil, could be put on a small "flag" at the top of the whip, or could be just 2 tape strips on a bumper.

How about it? Will you suggest it?

Ray Day WB6JFD
Palos Verdes CA

No – Wayne.

MAYDAY!

Enclosed is a memorandum from my log of a mayday that was received by JY3ZH, Zeedan Hussen, and myself 28 Nov 75.

Following is information I have been able to get from US authorities here in Germany and G3YPK in England.

1 Dec 75 I called US Air Force Europe, Air Rescue Service, Ramstein, Germany, trying to find out any information about W2ACS/MM. I was told by Major Bowen that the Air Force and Navy out of Italy had flown a total of 60 hours without any success. They also said they called the FCC trying to confirm the callsign W2ACS/MM. The FCC told them they had no record of the callsign ever being issued. They also could not find any information on the ship SCORPION.

G3YPK in London, England, notified the British Defence Ministry. G3YPK called me by telephone the 29th of Nov 75 saying the Defense Ministry had verified the callsign W2ACS/MM. They also could not find any registration on the ship SCORPION. I later found a 1956 callbook and found the call W2ACS.

I have tapes of the mayday that were sent to me by G3HAS from England. They are not complete but I can send a copy to you. They are of very poor quality.

There have been numerous rumors on 80 and 20 meters that W2ACS/MM was picked up. However, I cannot get US Air Force authorities in Ramstein, Germany to confirm this.

I realize that there is and will be a lot of criticism on how I handled the net but I'm up to it.

This is the first emergency I have ever encountered and now that it's over I know that if it ever happens again I will handle it much differently. I am better prepared.

At this point many amateurs in Europe are beginning to have their doubts about the mayday. There is widespread speculation that it was a hoax.

In a way I hope it was. I wish no one in the situation W2ACS/MM was in. The thing that bothers me is the way many amateurs here in Europe treated the mayday as a big joke. Contact with W2ACS/MM was lost many times due to interference (QRM) from many amateurs.

The upper 10 KCs of the 80 meter band is considered by a gentleman's-type agreement to be for DX only. Many operators tried to make us QSY because of this and when we didn't, caused considerable QRM. Many Europeans did not even know what a mayday was.

Myself, Zeedan and G3YPK managed to maintain control of the frequency for 7 hours. Many transmissions from W2ACS/MM were lost due to the QRM.

Would it be possible for you to investigate or turn this over to the FCC, since a US call was used? I do not know what to do. W2BFI Manuel R. Gonzales referred me to you. He is stationed here in Ansbach, Germany also.

Memorandum For Record:
Subject: Distress MAYDAY call received by DA1EK, 22: 5, GMT, 28 Nov. 75, from W2ACS/MM.

1. Reference: a) United States Army Technical Manual 11-490-7, with change 1. b) Laws Concerning Amateur Radio in West Germany. c) Federal Communications Commission, (FCC). d) Radio Amateur Law of 14 March 1949.

2. This is a memorandum for record to the log of DA1EK/WB5NDW/AE1EK.

3. Following is the information that was received from W2ACS/MM by this station, DA1EK, to the best of my knowledge. a) Date and Time: 28 Nov. 1975. 2:05 GMT, thru: 9 Nov. 1975, 07:15 GMT. b) Frequency: 3.793 and 3.796.

4. On the dates and times above this station received a MAYDAY distress call from: a) STATION: W2ACS/MM. b) NAME of OPERATOR: Tom Hapasig. c) LOCATION: 33.52 NORTH, 31.23 EAST. d) SHIP'S NAME: Private Vessel SCORPION. e) WEATHER CONDITIONS: Three to five foot waves; overcast skies; very low ceiling: light winds; no rain. f) Ship was taking on water fast due to a section of the mast breaking off and falling. The mast section punctured a large hole in the fiberglass hull. g) A total of five persons were aboard, which included his XYL. h) All Maritime emergency equipment had been lost. The only thing left was a Collins Transmitter (Amateur Gear), one portable emergency beacon, five life vests, and a life raft.

5. At approximately 22:20 GMT, 28 Nov. 75 this station, DA1EK, relayed by telephone the above information to the 1st Armored Division Staff Duty Officer, Capt. Trahey. He in turn notified the Emergency Action Officer at USAREUR Headquarters, Heidelburg, Germany.

6. The following Amateur operators took action to contact the proper authorities in their countries (as well as many others who I was not able to copy down due to the confusion and interference at the time). a) JY3ZH-JORDAN b) 4Z4FW-ISRAEL c) G3YPK-ENGLAND d) I2BYE-ITALY e) DA2AS-GERMANY f) DA2UD-GERMANY g) DA1GW-GERMANY h) G3ALI-ENGLAND i) G3HAS-ENGLAND j) G4CKL-ENGLAND k) GW3PDW-WALES l) GW3AX-WALES

7. Messages were relayed to W2ACS/MM from DA2UD by this station, DA1EK, concerning actions taken by US FORCES Rescue Parties. DA2UD had contact with a rescue operations center. Any information concerning these messages should be directed to DA2UD through the USAREUR MARS Director.

8. This station, DA1EK, was directed by W2ACS/MM to pass traffic for him. This station, DA1EK, then assumed emergency net control.

9. After many hours of work and long distance phone calls, G3YPK in England confirmed that W2ACS/MM was a legally licensed operator.

10. G3HAS in England notified this station, DA1EK, that he had everything down on tape and would send a copy as soon as possible.

11. Contact was lost with W2ACS/MM at approximately 03:30 GMT, 29 Nov. 75.

12. The above information is true to the best of my knowledge. There were many confusing moments due to the few Amateurs who thought it was a big joke.

13. In the opinion of this station only, DA1EK, I feel that the European Countries Governing Amateur Radio Service and Licensing should monitor and take action against those Amateurs who continually send unauthorized transmissions such as: a) Transmitting music and other commercial signals. b) Emission of unmodulated or unkeyed carrier. c) Require all Amateur stations to have and use a Dummy Load. f) Emission of spurious (SPLATTER) over 3 KCs. g) Establish laws concerning interference with a station who assumes net control with a distress MAYDAY call. h) Stop the gentlemen-type agreements and establish regulations concerning them.

14. All of the above caused confusion and almost panic on the part of W2ACS/MM. This is also the type of thing that the serious Amateur must put up with and look forward to every day.

SFC Frederick W. Woods
WB5NDW/DA1EK/AE1EK
HHC 1st Armored Div.
APO NY 09326

STRANGE

Isn't it strange that the league (ARRL) did not tell me when the Section Communications Manager ballots would be sent to voters in the Illinois section?

Isn't it strange that the current SCM knew well in advance so that he could plan his campaign?

Isn't it strange that I was told that the ballots would not be counted for a couple of weeks after the end of voting, and then was sent the results only 2 days after the voting deadline?

Isn't it strange that my request to the ARRL for finding out how many possible voters there were in that election (not names but a number) was unanswered?

Isn't it strange that many possible voters in the Chicago area (where I live) never received ballots?

Lawrence I. Cotariu WA9MZS
Former SCM Candidate
Skokie IL

be my guest

visiting views from around the world

Keeping Up With the State of the Art: What It's All About

. . . if a man neglects to keep abreast of his time, he yields the right to butter his bread with the milk of the Yak. — E. Haung-Ti

A few years ago, there appeared in *73 Magazine* an article which I ingeniously wrote entitled, "How I Read the Radio Amateur's Handbook and Found Happiness."

For the unlucky few who didn't read this incredibly clever piece of literature, or for those who did and can't remember, I will briefly summarize: First, I artfully described the anguish I suffered from knowing so little about electronics while trying to function in a social order that is at least 99.9% ham. I explained how miserable I was because I couldn't discuss capacitive-reactance with my wife. Then, with uncanny writing skill and insight, I gave both the remedy for my malady, which — in short — was reading the *Handbook* from cover to cover one Thursday night, and the result of my remedy — I could then talk freely about Ohms and Amps like Mac at Mac's Variety.

I have put those years to good use reviewing what I thought I had learned from reading the *Handbook* and have come to the conclusion that my comprehension of the state of the art at that time was not exactly what you would call keen.

Now, after so much time and investigation, I can see how ignorant I was. I can see how foolish I was to have come on so strong with so little ammunition. What a fool you must have thought me. You were right, I was a fool. But I know now where I went wrong. I have learned. For example: I'm embarrassed over the fact that I ordered a few dozen microfarads from the Radio Shack. I realize now that those guys at the Radio Shack were laughing *at* me, not *with* me. I now realize that the dipole I put on my roof needs a rig for it.

Those were bad days!

But like I say, that's all changed now. I've seen the light. I have learned what electronics is all about. Instead of waddling, eyes closed, through the mammoth sea of ignorance, I have courageously peered through the window of knowledge and astutely grasped all the what-once-were-difficult concepts that govern the complex world of electrical phenomena.

It's a thrill to be totally cognizant, to be aware of that broad definitive line that separates knowledge from ignorance, and what's more . . . *to cross it.*

Contrary to what some philosophers might propose, *awareness* is bliss.

I now understand the world of electronics. I have a thorough working knowledge of all its component parts, its idiosyncrasies, its seemingly enigmatic behavior patterns, its wonders. I'm on top of it. Aware. The reason, you see, is that I've read another book.

Well, actually, it wasn't really a book, it was more like a magazine. *Electronics Stuff* or *Build Your Own Electric Things* I think it was called. Whatever its name, it certainly was a wealth of information, a real education.

There was one article in there that described just how to go about building an electric spoon. Another had complete instructions (including the schematic) for constructing a device that detects the whereabouts of pine cones. If I'm not mistaken, I think it was called a "pine-cone detector." Another project — and one that really interested me a lot — was building a multimeter, and I probably would have gone right ahead and built one if it wasn't for the fact that I didn't have any multies in the house at the time and therefore no need to meter them.

But I'm getting away from the subject.

The subject is of course that by reading a *second* electronics book, I have taken one step toward keeping abreast with the state of the art, which I now realize is all important.

What good, when you stop to think about it, is a doctor who, while in doctor school ten years ago, learned a lot about bellies and heads, but hasn't read a single journal or some other kind of doctor book concerning those two vital body parts since? State of the art . . . that's really what it's all about.

Yet, you'd be amazed to find out how many so-called knowledgeable, seemingly competent, well-known champions-in-their-field-type people there are who *haven't* kept up with the state of the art.

Example: Miss Graham, my third grade grammar school teacher, who, I was convinced, knew everything there was to know in the whole world, for one entire school year insisted that "knowledge is power." Obviously, Miss Graham knew nothing about wattage.

Another more amazing example was a man with whom we are all familiar, admired, a man whose ideas helped shape the world into what it is today, a man who was truly a genius, a giant in his field. But a man who made one fantastic error that has gone undetected for decades. Of his oversight, his lack of knowledge and the reason for it, I am now aware. This man, you see, giving him all the respect due him, could not possibly have kept up with the state of the art and still proposed what he proposed.

I'm referring of course (if you haven't already guessed) to none other than Albert Einstein. And the error I'm referring to is this: For a quarter of his lifetime, Albert Einstein, scientist, mathematician, philosopher, suffered under the illusion that voltage . . . get this . . . was equal to mass times the speed of light squared ($E = mc^2$).

WOW, CAN YOU BEAT THAT?

Finding this out was like being ten years old and discovering that Johnny Weismuller couldn't swim. WOW!

How could this be? How could this man in all his wisdom and glory actually believe that? Do you realize that he built his entire relativity theory on that?

The sad fact is, both Einstein and Miss Graham were wrong. They were wrong not because they were stupid — neither was stupid. I didn't know Einstein, but I'd bet a week's pay that *he* wasn't stupid. Yet . . . and yet, they were both wrong. Why?

As I see it, they were wrong for one reason and one reason only, and that is simply that neither Mr. Einstein or Miss Graham kept up with the state of the art. And it's as simple as that. (I've often wondered if Einstein and Miss Graham knew each other.)

Not to belabor the point, but Einstein not only neglected to keep up with the state of the art, but completely ignored the *Handbook*.

So like I say, as you can probably see for yourself by this time, keeping up with the state of the art is all important.

The question now arises, of course, as to how to keep up with the state of the art.

Simple. Collect the two magazines I've read, or if you want to go overboard, maybe even a few more. For the real state of the art freak, there are also correspondence courses, but I figure you've got to be realistic and draw the line somewhere.

No matter how you cut the pie, whether it's two magazines or two thousand magazines, there's a lot of learning to be done. The directions in which modern technology has taken us are pretty hairy to say the least: JFKs, flip flips, AND and ARE gates — who knows where it's all going to end. Not to even mention digital logic, which is a whole other bag of worms.

The road is tough, but to really stay on top, to really know what's happening, to really know what it's about, the road must be followed. To do so is keeping up with the state of the art, or, if you prefer, "buttering your bread with the milk of the Yak." And *that*, my friend, is *really* what it's all about.

Robert W. Johnson
Salem NH

Looking West

Bill Pasternak WA6ITF
14725 Titus St. #4
Panorama City CA 91402

"Good-Guy, the Gold-Plated Radio" — that's the final title assigned to the latest "epic production" soon to come forth from the Palisades Amateur Radio Club motion picture staff. As regular readers will recall, about a year ago I mentioned that we were documenting on film all the events surrounding the acquisition by PARC of their new MICOR Repeater and Stationmaster Antenna that was to replace the old "A" strips and J-Pole that had served PARC quite well for many a year.

The main reason that I mention this now is due to the many inquiries as to when the film would be available for showing to interested groups in other areas as well as out here. It looks as though late April would be a fair guess, since we have finally gotten into the most important aspect of filmmaking — that of post-production. At the moment, there is about 1800' of Super 8 mm film that must be edited into 28 minutes of story complete with a happy ending. There is also a musical score to add, narration to write, and umpteen other details that I personally know little about. This enormous task is being undertaken by one of the finest professionals in the motion picture industry, George Hively WA6YEA. Those of you who saw "The Longest Yard" in theaters or the TV program "Thrill-seekers" have already seen a sample of George's expertise. Amateur clubs that have seen the first PARC film "Field Day 71" have gotten the chance to see how a true professional like George can build an excellent story from a few hundred feet of assorted home movies. PARC is lucky to have a George Hively as one of its devoted members, but I too am lucky to have a friend such as George who has taken the time and has had the patience to share some of his knowledge with a neophyte filmmaker such as yours truly. Without this beautiful guy, I doubt if I would have had the guts to take on the project of "Good-Guy, the Gold-Plated Radio." Friendship — to me that's the true meaning of amateur radio.

To answer some of the questions that have come in concerning the film, let me give you the following information. Originally, we had hoped to do this film in 16 mm with an optical soundtrack. When I found out what that format would cost, it was decided to revert once again to Super 8 mm. In the meantime, a number of camera manufacturers have introduced a line of Super 8 mm sound-on-film cameras and projectors. Unlike 16 mm, Super 8 mm is a magnetic rather than optical sound system, and the recording technique used is identical to that of any tape recorder. If you have a camera that is capable of recording, film is available that is pre-soundstripped and you can record lip synchronized sound as you take the picture. The other alternative is to shoot silent film and then have the soundstrip added at the time of film processing or after editing, as it will be in our case. We chose the latter method since I already owned two fairly decent Super 8 mm cameras and our sound track (narration plus music) won't be added until after all other post-production work is done. It was just plain more economical that way, since most of the aforementioned 1800' of film will be discarded when we boil it down to 400' of finished product. Therefore, PARC invested in a GAF Super 8 mm Sound Recording Projector rather than a sound camera, as we figured that for us it would be more beneficial. Already, the sound track for "Field Day 71" has been recorded on the film so that lugging a tape deck, amplifier and speaker with us to show it has become a thing of the past. Also, PARC can now mail out this film without providing a detailed instruction sheet as to how to synchronize the sound with the picture, and more important, how to keep them together throughout the film. Having run it many times, I can tell you that it was no easy job. "Field Day 71" is still available from PARC free of charge by sending a letter to the Palisades Amateur Radio Club of Culver City, PO Box 2453, Culver City CA 90230. Please mark the envelope to my attention and use the words "Film Request" on the envelope. Also, please be patient, since there is only one distribution print of this film at this time and there is a waiting list.

What the foregoing leads to is this. In a day when amateur radio must do everything possible to garner good public relations, a relatively inexpensive means to that end is now at hand, thanks to the advent of Super 8 mm sound-on-film photography. For about $450, the price of a synthesized two meter radio, your club can have the basic tools to produce your own films about amateur radio and how your particular organization fits into and serves your community. You have the ability to produce your own public service announcements about amateur radio that can be aired by any TV station equipped to run Super 8 mm magnetic sound film. (I suggest that you first check with your local TV outlets before doing the aforementioned to be sure they have the facilities to put what you produce on the air. While more and more stations are obtaining Super 8 mm film chains, not all are so yet equipped.) Even if you just want to document club happenings for club use alone, the added dimension of sound adds so much to a film. Again, this is one of those adventures limited only by your own imagination. In coming months I will try to give some more ideas on the use of this medium to improve the public image of amateur radio. In the interim, if you have any suggestions along these lines, pass them along to me and I will get them into print for you, here in Looking West.

Were you or better yet your children lucky enough to catch the children's program ISIS on Saturday, November 15th? If you did, then you caught the episode titled "No Trumpets — No Drums," written and produced by Art Nadel W6TZY. The story dealt with the "good people" discovering the hiding place of the "bad people" in a ghost town. Though our "good people" are discovered by the criminals and held semi-captive as the "bad people" prepare to escape, one of our co-heros is an amateur who has a TR-22 in the car. He is able to sneak back to the vehicle, retrieve the radio, make a few quick repairs to it (it was intermittent in an earlier scene), and use it to summon help. In the end, amateur radio and the law will out and the criminals are captured.

Sounds a bit corny you say? Sounds basic and childish? Well, remember it was a program designed to be viewed by children and to both teach and entertain at the same time. In regard to the latter, Art went to great length to carefully yet simply explain what amateur radio was and even how one became a member of our amateur community. He does this by having his lead character, a high school student, explain the difference between amateur radio and other radio services to a teacher that is judging his "Science Fair" type project based on a demonstrating amateur radio. He demonstrates the utility of international Morse Code as one of amateur radio's communication tools a bit later when our high school student has an auto accident and is trapped in his vehicle half way down the side of a hillside. Our amateur/hero taps out SOS on his auto's horn. Luckily, the super heroine of the series, ISIS, comes to his rescue and, using her super powers, saves not only him, but his vehicle as well.

Not long ago, in this very column I stated that I felt it would be today's children that would hold the key to the future of amateur radio, and that we as today's amateurs had an obligation to see that they were educated as to what challenges were offered by becoming amateur radio operators, and had their imaginations stimulated enough to take steps in that direction. If you agree with me, then the work done by Art Nadel W6TZY in "No Trumpets — No Drums" is definitely a giant step in that direction. Therefore, this is my personal and public letter of thanks to him and his staff for one heck of a good job, and I sincerely hope that he and others in the same profession with access to the mass media will continue in that direction. If we can stimulate America's "little people," offer them the imaginative challenge to be found as members of the amateur radio community, then we can insure a bright future.

Another program that will be treating amateur radio in a favorable light will be an upcoming episode of the TV adventure series "Harry O," tentatively titled "Book of Changes." While details are still sketchy on this one, I have been told that we will be treated in a very favorable light and most important, on the side of the "good people." More on this as soon as information and an air date is available.

One thing I would like to suggest. If you decide to write to the networks complimenting them on such programming as this, don't be picky about technical details. Don't write letters telling how much you enjoyed the program and then go into a five page tirade because this was not correct or that didn't seem perfect. Remember, you are dealing with an entertainment media and there are two things to be considered. First, not all TV script writers are licensed amateurs, and in fact, I suspect that very few are. What they know of our hobby they have learned either by accident or through necessity. Maybe one of these people was stuck on a freeway and an amateur stopped to offer assistance, or the guy has a neighbor involved in amateur radio. Either way, in most cases their technical knowledge of amateur radio is usually limited, so let's be thankful for the fact that they are now treating

us as an asset to society rather than a liability.

Also it is important to remember that TV is basically an entertainment vehicle and that what is shown must be easily understood by the general public without their having to run out and locate a copy of the Rules and Regs along with an FCC official to interpret them. If the dialogue sometimes sounds cornball, or if you wish that the QRM level on 20 was as low in real life as it is on the tube, remember you are being entertained along with millions of other people. Most important, TV production companies are beginning to realize the viability of amateur radio and are starting to integrate it more and more in a *positive* way into their programming. Perhaps my dream of having the title "amateur radio" as household words, understood and respected by all, will become a reality yet. At least the seeds have been planted.

Television has two basic jobs in my opinion — that of education as well as entertainment. There are times when it is possible to totally integrate the two, as in the case of Art Nadel's "No Trumpets — No Drums," and there are also times when the educational aspect takes a back seat to the entertainment aspect. Conversely, there are also times and places when entertainment can take a back seat to education, and such is my latest project. I am trying to produce the world's lowest budget educational television program, and if I am lucky I might just pull the whole thing off. I am planning a one hour informal roundtable discussion between amateurs of varied interest backed up by color slides and remote interviews utilizing what I have learned about Super 8 mm sound photography to keep the cost of these "remotes" to a minimum. Thanks to the technical staff of Public Broadcast Station KVST, things are beginning to take shape and a finished vehicle may be ready for airing by late March or early April.

The moderator and guests will all be amateurs, and the purpose of the program will be to explain in simple, non-technical language who we are and what we are all about. We will show amateur radio as a hobby, as an educational tool, as a method of communication in times when no other form of communication exists, and as a therapeutic tool in the recovery of people from serious illness. The whole project started almost a year ago when one of the KVST staff members attended a PARC meeting (the fellow is an amateur) and happened to see the field day film. He asked me about getting it to air on their station, but for reasons beyond our control that was not possible. We did chat, however, about putting together a program about amateur radio and the matter sort of died at that point. I was too busy filming "Good-Guy" and writing to get involved in anything else. Then two events took place. "Good-Guy" was "in the can" ready to be edited by George and I happened to run into Chris WB6HGW, another KVST staff member, at about the same time. My conversation with Chris led to further conversations with others on the subject and out of all this has come "Amateur Radio's Wide Horizon," my tentative title for the program. You may ask what a TV service technician such as yours truly is doing producing a TV program. Well, someone has to do it or it won't get done. For me it is a learning experience as well as doing a bit more to help publicize amateur radio. Whether it will ever get aired I cannot be sure at this time, but if it does, it will probably be the first program of its length done for about $99.95 or so. Talk about low budget...

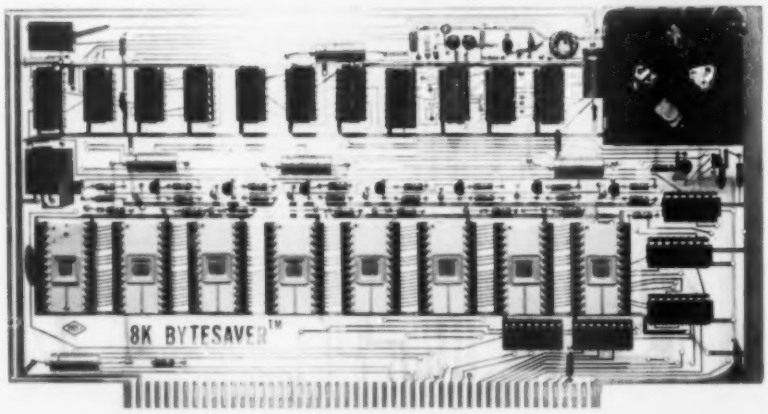
About two weeks ago, the formative meeting of the Southern California Amateur Radio Public Relations Committee was held to get the ball rolling toward obtaining some good "PR" for our amateur radio community. Chaired by Lenore Kingston Jensen W6NAZ, the 40 or so of us that attended the meeting spent about three hours discussing the many various ways that we could obtain media coverage for our many varied activities, and more important, what form of media coverage was best suited to a given event. In forthcoming issues, I will go deeper into some of these, but for the present let me just cover the major accomplishments of the evening. First, it was decided that we would produce and distribute a simple PSA (public service announcement) that would briefly explain what amateur radio is and provide a telephone number and addresses where more information could be obtained. Something simple and inexpensive like a few color slides with about 30 seconds of copy to be read by an announcer or put on a tape cartridge. Inexpensive but effective.

Next, a Public Relations Net was formed that now meets through the facilities of the WR6ABN repeater system (147.82/.24) every Thursday evening at 7:30 pm local Pacific time. Its purpose is to take inputs on newsworthy amateur radio events and channel them through Lenore to the proper media sources for dissemination to the general public. It is urged that *every* radio club and repeater organization in Southern California appoint a public relations spokesperson to this committee and have that person check into this net hosted by Burt WA6MQV. A low-band net on 75 or 40 is also being discussed so that those people outside the coverage area of WR6ABN can also take part in this truly worthwhile program.

If your group happens to fall into the latter group (that which is not within the coverage area of the WR6ABN repeater system) and you wish to take part in this ongoing public relations program, a program that may well help insure the future of our amateur radio community, then drop a line to Lenore (she is listed in the callbook) or to yours truly and I will channel such letters to Lenore. Next month, I will continue with what I promised for this month; the Ventura Convention and the SCRA meeting wrap-up as well as more on what began here in the field of amateur radio public relations about two weeks ago.

In the interim, if you in other parts of the nation want to get started in the same direction that we are taking here, I will be happy to share what knowledge I have garnered with you either through personal communication, or if it keeps growing, through a series of articles apart from Looking West. It's up to you. I will write them if you will provide the inputs. True, we have made a great beginning, but there is yet a long road to travel. Working together both locally and nationally we can achieve that goal. We can achieve public recognition, and more important, public respect. It simply takes each of us doing his or her share. I believe we can.

NEW PRODUCTS



BYTESAVER™

Cromemco of Los Altos, California has a nice gadget for use in the Altair 8800 computer ... it's an 8K PROM board designed to plug right into the Altair and it has a built-in programmer for the PROMs.

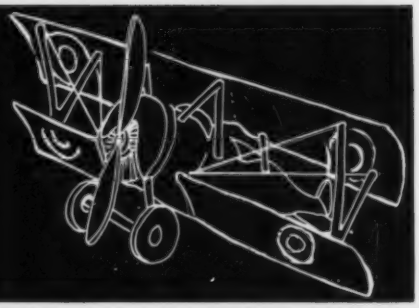
This is an excellent way to keep, say, the 8K BASIC program right on tap for the Altair, ready to use immediately when the computer is turned on. After a few dozen times of hand switching in the 19 step loader and then playing the five minute cassette loader for BASIC, you'll be ready for a ROM memory for the works.

In addition to making the start up of the Altair duck soup (to coin a phrase), there is a little matter of keeping the program in good shape. Little glitches in the power line come along and knock out some of the RAM memory now and then, introducing errors into the program with the result that in ordinary operation you have to refresh the program every now and then by starting over and running it in from tape. With the program in ROM it won't deteriorate.

Then, one other factor, the cost of the memory alone. The Bytesaver™ costs $195 in kit form vs. twice that for the Altair 8K in dynamic RAM.

Cromemco, 1 First St, Los Altos CA 94022, if you want more details.

Autobiography of an Ancient Aviator



W. Sanger Green
1379 E. 15 Street
Brooklyn NY 11230

HOTEL RANGES AND A REAL CLOSE ONE

I had just returned to Brooklyn from a six month Air Service active duty tour at Langley Field, Va., so the first thing on my calendar was to get a job. I could go back to selling Hupmobiles but that was a dead end street. My father-in-law told me that the Michigan Stove Company of Detroit was looking for a man to handle their hotel and restaurant kitchen range business (wholesale) in south New Jersey, Pennsylvania, Delaware, Maryland and D.C., with headquarters and warehouse at Philadelphia. So I phoned, made an appointment, and went to Detroit to see about the job, since nothing worthwhile was doing in the aviation business. They offered me the position with a good salary and liberal traveling allowances, and I accepted. The next ten days were spent at the factory familiarizing myself with the various products I would be handling, getting all the information I could about the firms and people I would be dealing with in the territory, and all available information about our one competitor and its products.

It took me awhile to get acquainted with the hotel supply house and gas company salesmen as well as the chief chefs in the larger hotels and restaurants. Regular calls on these and A & E firms doing plans and specifications for new hotels in my territory produced a good flow of business. Detroit was happy.

One very lucky experience comes to mind. I was just finishing breakfast one morning in Atlantic City when the fire sirens sounded. I walked up the boardwalk to see where the fire was. It happened to be in the rear of one of the larger hotels in town — right where their kitchens were located. The fire was brought under control very quickly but it had gutted both the American plan and European plan kitchens. I knew the head chef so I found him and told him that I had all the equipment to put him back in business at my Philadelphia warehouse and could have it shipped out that afternoon. Then, with the gas company's help, I could start installation as soon as he could get the debris cleaned out. I got the Atlantic City Gas Company representative over and he, the chef, and I made up the new kitchen layouts. The old equipment had been in use for about 12 years so the hotel manager thought this was a good time to install new ranges, etc.

> **Ralph claimed to be the only man to bite himself in the behind . . .**

(fire insurance, you know). Anyway, the gas company got its order, I got my order from them, and had the ranges on their way that afternoon. The importance of the order can be gauged by the fact that the gas company man (a noted tightwad), who worked on a salary plus commission, took me to Hartney's that evening for a lobster dinner. Detroit also came along with a nice raise.

One of the trips I made for the stove company was to Dayton, Ohio. Several of my Kelly Field classmates were stationed at McCook Field, near Dayton, so we got together for a reunion. They brought along Ralph Lockwood, who was chief test pilot at McCook. Ralph claimed to be the only man to bite himself in the behind. He said it came about like this: He had false teeth that didn't fit very well so when he was getting ready to take off for a test flight he would put them in his rear pants pocket. This day he parked his teeth, put on his parachute and took off. About 1000 feet over the field the engine blew up, taking a lot of the front end of the ship with it. So Ralph bailed out. When he hit, it was at a pretty good clip. He landed on his gluteus maximus with his false teeth making his only wound. He swears that's what happened.

In 1927 I was on active duty at Mitchel Field, L.I., the last two weeks in July. On my way home from Mitchel I stopped by at Curtiss Field to visit some of my friends there. While we were talking, Casey Jones came over and said he had a photo mission over Manhattan and would I like to take it. I said I'd be glad to help out so they rolled out an old C-6 Standard, put the photographer and his cameras in the front cockpit and away we went. We were only a few minutes out of Curtiss and over New Hyde Park when there was a fair-sized explosion up front, no more power and the ship became quite tail heavy. Then I saw that we had a pretty good fire going up forward where the six cylinder engine block had been. The gas tank in this ship was in the center section over my passenger. There was a petcock in the gas line from the gas tank to the engine and I tried to get the passenger to turn it off and stop feeding gasoline to the fire. The fellow was too scared to move, so, as the flames blowing back were getting pretty hot, I had to side slip to keep them away from the fuselage. There was not much choice as to landing place, so I slipped to within a few feet of the ground and landed in a small potato patch. By that time the right wing was burning briskly, so I hauled the photographer and his cameras out of the front cockpit just before the gas tank exploded. A water pumping station was nearby so I borrowed their phone to advise Curtiss Field of the good news: one Standard they wouldn't have to scrap. Ed Conerton came over to pick us up. When we got back to Curtiss, I offered to take the young man on his mission in another ship but he was too badly shaken. So Ed and I retired to a nearby speakeasy to freshen up a bit. I later learned that the C-6 engine block that left me without warning landed in a service station in New Hyde Park but did no damage — just scared them.

A few days after this I received a wire from Lockwood, who had joined the newly-formed Aeronautics Branch of the Department of Commerce, asking me to come to Washington to talk about joining them. The next week I went down to see what was going on.

In 1926 Congress passed the Civil Aeronautics Act, under which was established an Aeronautics Branch in the Department of Commerce. Its function was to exercise a certain amount of control over civil aviation by means of licensing pilots, mechanics, aircraft and engines. William P. McCracken was appointed Assistant Secretary of Commerce for Aeronautics, and Clarence M. Young, Director of Aeronautics. With the help of Gil Budwig, Dan Scarritt and Ralph Lockwood, they were in the process of recruiting a group of qualified inspectors to do the examining and testing for the licenses.

They offered me the job as supervising inspector of their no. 2 region, which consisted of south N.J., Penna., Del., Md., Va., W.Va., N.C., and D.C. The salary was less than I was getting with the stove company, but the job was important in aviation and I figured it would put me in contact with some of the top people in the business. While I was there I got my transport pilot license (#73) and also an aircraft and engine mechanic license. I agreed to start work for them on November 1. That meant moving my family (Cleo and Wayne) to Philadelphia, where my headquarters would be.

Next month I'll tell you about my 15 months as a Supervising Inspector during the aircraft engine transition period from OX5s to the new radial engines. Hold on.

HAM HELP

I can offer "Ham Help."

Donald A. Huettl WBØMBY
11349-6th St. NE
Blaine MN 55434

I have written you before about how difficult I and others like myself who have not had an electronic background have found it to get help to become a ham. Your tapes have been very helpful to me. In fact, I took my Novice exam Wednesday, given to me by Al Cook WA1RIT (hope I passed).

Help by hams is hard to find, almost as hard as finding hens' teeth. Thanks to Bill Loeffler W1PFA, owner of Camercraft of Lawrence, Mass., Bill Longworth WA1HWE, John Scofford WA1OAQ, and all others who organized amateur radio classes at Salem H.S. This class consists of males and females, young, middle aged and older folks. This class started with about 60 and still has over 50 attending. I will try to send a picture of the class when the class is graduated.

Keep up your help column and list other hams' names who really want to give help.

I'm hoping the FCC will soften the theory part of the exam, but I believe the code should be required and ten (10) wpm should be required on all exams.

Basil W. Polinchak Sr.
Andover MA

CONTESTS

Editor:
Robert Baker WA1SCX
34 White Pine Drive
Littleton MA 01460

Please be sure to send all contest information to WA1SCX at least 3 months prior to the event's date, so that we can be sure to get it included before the publication deadline.

ARRL NOVICE ROUNDUP
Starts: 0001 GMT Saturday, February 7
Ends: 2359 GMT Sunday, February 15

The contest is open to all amateurs in any ARRL section. Operating time must not exceed 30 hours total during the 9 day period while off periods may not be less than 15 minutes at a time. Times on and off must be entered in your log. Crossband contacts are not allowed. Novices may work anyone while non-Novices must work Novices only. Each station may be worked only once regardless of band.

EXCHANGE:
RST and ARRL Section.

SCORING:
Each completed QSO counts one point. The total multiplier is the number of ARRL sections and foreign countries worked. VE8 counts as a separate section. The final score is the number of QSO points plus your ARRL Code Proficiency credit (15 wpm = 15 pts.) times the total multiplier.

AWARDS:
Certificates will be awarded to the highest scoring Novice in each ARRL section. Multi-operator or higher class licensees are not eligible for awards but the top ten scores will be listed in the results.

LOGS:
Use official ARRL forms available from: ARRL, 225 Main St., Newington CT 06111. All entries should be sent to this same address.

Please check the January 1976 issue of QST for any last minute changes in rules or operating times.

YL-OM CONTEST
PHONE
Starts: 1800 GMT Saturday, February 21
Ends: 1800 GMT Sunday, February 22
CW
Starts: 1800 GMT Saturday, March 6
Ends: 1800 GMT Sunday, March 7

Sponsored by the YLRL, the contest is open to all licensed operators throughout the world. All bands may be used but crossband operation and net contacts are not permitted. Phone and CW contacts will be scored as separate contests, so please submit separate logs. A station may be contacted no more than once in each contest for credit.

EXCHANGE:
QSO number, RS(T), and ARRL section or country.

SCORING:
One point is earned for each station worked, YL to OM or OM to YL. Multiply the number of contacts by the number of different ARRL sections and/or countries worked. Contestants running 150 Watts input or less on CW and 300 Watts PEP or less on Phone may multiply the score by 1.25 (low power mult).

LOGS:
Entries in your logs must show band worked at time of contact, time and date, and transmitting power. Copies of all logs showing claimed scores and signed by the operator must be postmarked no later than March 24, 1976 and received by the contest manager not later than April 18, 1976 or they will be disqualified. Please remember to submit separate logs for Phone and CW. Send logs to: YLRL Vice President, Beth Newlin WA7FFG, 826 W. Prince Rd – 06, Tucson AZ 85705.

AWARDS:
A cup will be awarded to the first place YL and OM on both Phone and CW. Second and third place winners in each contest will receive certificates. Certificates will also be awarded to the high score Phone and CW winners of each state, VE call area, and each country. The winner of the Phone contest cup is also eligible to win the CW cup.

Be sure your logs are legible; no logs will be returned.

SOUTH DAKOTA STATE QSO PARTY
Starts: 1400 GMT Sunday, March 14
Ends: 0200 GMT Monday, March 15

The contest is sponsored by the Prairie Dog Amateur Radio Club. No South Dakota to South Dakota contacts will count. Same station may be worked on different bands or modes or in different counties for multipliers.

EXCHANGE:
SD stations give RS(T) and county, all others will send RS(T) and state, province or country.

SCORING:
For SD stations, final score is number of contacts times the number of states, provinces or countries. All other stations, final score is the number of contacts times the number of counties (67 max).

FREQUENCIES:
CW – 70 kHz up from bottom of band; Novice – middle of Novice band; Phone – 1.975, 3.955, 7.230, 14.280, 21.370, 28.510.

AWARDS:
Certificate to highest single and multi-operator entry in each section.

ENTRIES:
Send signed declaration and claimed score to: WBØEVQ, Box 493, Springfield SD 57062, by April 30, 1976.

CQ WORLDWIDE WPX SSB CONTEST
Starts: 0000 GMT Saturday, March 27
Ends: 2400 GMT Sunday, March 28

Only 30 hours of the 48 hour contest period permitted for single operator stations. The 18 hours off may be taken in up to 5 periods during the contest, but must be clearly indicated in the log. Multi-operator stations may operate the entire 48 hours. All bands, 1.8 to 28 MHz may be used but all QSOs must be 2xSSB only.

ENTRY CLASSES:
Single operator, all band or single band; multi-operator (all band only), single or multi-transmitter; multi-operator, multi-transmitter only allowed one signal per band.

EXCHANGE:
RS and 3 digit progressive QSO number starting at 001, use 4 digit number over 1000; multi-transmitter stations use separate numbers for each band.

POINTS:
QSOs with stations on different continent – 3 points on 14 to 28 MHz, 6 points on 7 to 1.8 MHz. Contacts between North American countries (not your own) count 2 points on 14 to 28 MHz, 4 points on 1.8 to 7 MHz. Contacts between stations in the same continent but not in same country count 1 point on 14 to 28 MHz, 2 points on 1.8 to 7 MHz. Contacts between stations in the same country count only for multipliers, not for QSO points.

MULTIPLIER:
The multiplier is the total number of different prefixes worked regardless of band. Each prefix may be counted only once. Each special bicentennial USA prefix worked counts as a multiplier of 2.

SCORING:
Single op, all band and multi-operated stations – total number of QSO points from all bands times the total multiplier. Single op, single band – total number of QSO points from that band times the multiplier. NOTE: A station may be worked once on each band for QSO points, but the prefix multiplier is only counted once.

AWARDS:
Certificates will be awarded in each category in each country, and each call area in US, Canada and Australia. Other special awards and trophies will be awarded as listed in *CQ Magazine*. To be eligible for awards, single oper-

CALENDAR

Feb 7 - 15	ARRL Novice Roundup
Feb 14 - 15	10-10 Winter QSO Party
Feb 21 - 22*	ARRL DX Contest – CW
Feb 21 - 22	YL-OM Contest – Phone
Feb 28 - 29*	French Contest – Phone
Mar 6 - 7*	ARRL DX Contest – Phone
Mar 6 - 7	YL-OM Contest – CW
Mar 13 - 14	BERU
Mar 14 - 15	South Dakota QSO Party
Mar 20 - 21*	ARRL DX Contest – CW
Mar 27 - 28	Tennessee QSO Party
Mar 27 - 28	CQ World Wide WPX Contest – SSB
Mar 27 - 29	BARTG Spring RTTY Contest
Apr 3 - 4	Florida QSO Party
Apr 3 - 4	CD Party – CW
Apr 3 - 4	SP DX Contest
Apr 10 - 11	CD Party – Phone
Apr 24 - 25	PACC
Apr 24 - 25	Delta QSO Party
May 1 - 2	Helvetia 22 Contest (H22)
June 4 - 7	IARS/CHC/FHC/HTH QSO Party
June 12 - 13	ARRL VHF QSO Party
June 26 - 27	ARRL Field Day
July 3 - 4	QRP – Summer – Contest
Aug 14 - 15	European DX Contest – CW
Sept - 12	European DX Contest – Phone
Oct 30 - 31	CQ World Wide DX Contest – Phone
Nov 5 - 8	IARS/CHC/FHC/HTH QSO Party
Nov 13 - 14	European DX Contest – RTTY
Nov 14	OK DX Contest
Nov 27 - 28	CQ World Wide DX Contest – CW

* = described in last issue

ator stations must work a minimum of 12 hours; multi-operator stations must work a minimum of 24 hours.

LOGS:

Show all times in GMT, use a separate sheet for each band. Prefix multipliers should be entered only the first time they are contacted. Logs should be checked for duplicate QSOs and prefix multipliers. It is recommended that you use a prefix check sheet and include it with your entry. Each entry must be accompanied by a summary sheet listing all scoring information, category, and your name and mailing address in block letters. Also, a signed declaration that all contest rules and regulations for amateur radio in your country have been observed should be included. Official logs and summary sheets are available from *CQ Magazine*. Send a large self-addressed envelope with sufficient return postage or IRCs to: CQ WW WPX SSB Contest Committee, 14 Vandeventer Avenue, Port Washington, LI, NY 11050. All entries should be postmarked no later than May 1, 1976 and addressed to the address shown above. The deadlines will be made more flexible in rare isolated areas.

Please check the January issue of CQ Magazine *for complete rules and changes made at the last minute.*

TENNESSEE QSO PARTY
PERIODS:
2100 GMT Saturday,
March 27 to
0500 GMT Sunday,
March 28; 1400 GMT to
2200 GMT Sunday,
March 28

Tennessee stations on Phone, call "CQ TENN QSO PARTY," or on CW call "CQ TN." Test variations to encourage contacts from non-contestants will result in disqualification. Repeater contacts are not allowed. Mobiles compete against mobiles, portables against other portables. Minimum of 5 contacts from each county for mobiles and portables to earn bonus points.

EXCHANGE:

Tennessee stations send signal report and county. Out of state stations will send signal report and state, province or country. Each station may be worked twice on each band, once on CW and once on Phone. Mobile and portable stations may be worked each time in a different county.

SCORING:

Score one point for each Phone QSO and 1.5 points for each CW QSO. Tennessee stations multiply total number of QSO points times the sum of different states, provinces, and Tenn counties — include Tenn as a state also. Portable and mobile stations receive 200 extra bonus points for each county outside their home county they operate from. This bonus is added to their total score after using the multiplier. Out of state stations, multiply the total QSO points by the total number of Tenn counties worked.

FREQUENCIES:

3550, 7050, 14050, 21050, 28050, 3725, 7125, 21125, 28125, 3980, 7280, 14280, 21380, 28580

LOGS:

Logs must show: date/time in GMT, station worked, band, mode, exchange and score. Use separate logs sheets for each band over 25 contacts made on. Submit cross check sheet if you make over 100 contacts. Logs must be legible to avoid disqualification. Mailing deadline is April 25, 1976. Include a self-addressed stamped envelope if eligible for certificates; every entry will receive a summary of the QSO party with a certificate if eligible. Send logs to: Dave Goggio W4OGG, 1419 Favell Dr., Memphis TN 38116.

AWARDS:

Plaques will be awarded to the top score in and outside of Tennessee and to the winning portable and mobile. Certificates will be given to every station sending in a log with 10 contacts or more.

DEHC

Enclosed is some information about Ecuador's new Diploma for Amateurs and SWLs. Please let your readers know about it in your magazine.

Diploma De La Linea Ecuatorial (DEHC). This FB DIPLOMA is available to stns making required contacts with stns in HC-ECUADOR, the land of, and named after the EQUATORIAL LINE. AF, AS, EU, OCE ... 1 QSO. Any Novice ... 1 QSO. N.Am., C.Am ... 2 QSOs. S.Am ... 3 QSOs. Any band, mode. Ok for SWLs. QSOs from 15 Nov 1945 count. To apply send: List of QSOs, 1 dollar U.S. or equivalent, or 8 IRCs to:

DEHC Mgr. R. Dorsch HC5EE
PO Box 253
Cuenca, Ecuador

BARTG SPRING RTTY CONTEST
Starts: 0200 GMT Saturday, March 27
Ends: 0200 GMT Monday, March 29

Only 30 hours of the total 48 hour contest period may be operated. The 18 hour rest period can be taken at any time, but off periods may not be less than 3 hours at a time. Times on and off the air must be summarized on the log and score sheets. There will be separate categories for multi-operator and SWLs. Use all amateur bands from 3.5 to 28 MHz. Stations may not be contacted more than once on any one band. In addition to the ARRL country list, each W/K and VE/VO call area will be counted as a separate country.

EXCHANGE:

Time in GMT, must be a full 4 figure group — use of "same" or "same as yours" will not be permitted. RST and message number. Message number must consist of a 3 figure group starting with 001 for the first contact.

POINTS:

All 2-way RTTY contacts with stations within one's own country will count 2 points. All 2-way RTTY contacts with stations outside one's own country will count 10 points. All stations will receive a bonus of 200 points per country worked including their own. NOTE: Any one country may be counted again if worked on another band, but continents are counted only once.

SCORING:

The total score is the sum of (the 2-way exchange points times the number of countries worked) plus (the number of countries worked times the country bonus points times the number of continents).

LOGS & SCORE SHEETS:

Use one log sheet for each band and indicate any rest periods. Logs must contain: date and time in GMT, call-sign of station worked, RST report and message number sent, RST report and message number received, and exchange points claimed. All logs must be received by May 31, 1976 to qualify. The judges' decision will be final. Send contest logs to: Ted Double G8CDW, 89 Linden Gardens, Enfield, Middlesex, England EN1 4DX.

AWARDS:

Certificates will be awarded to the leading stations in each class and to the top stations in each continent and each W/K VE/VO call area. The final positions in the Results Table will be valid for entry in the "World Champion of RTTY" Championship.

If any contestant contacts 25 or more different countries (W/K VE/VO call areas do not count as separate countries for award) on 2-way RTTY during this contest, a claim may be made for the QUARTER CENTURY AWARD issued by the British Amateur Radio Teleprinter Group and for which a charge of $2.00 or 8 IRCs is made. Make your claim at the same time as you send in a contest log. Holders of existing QCA Awards will automatically have any new additional countries added to their records.

If any contestant contacts stations on 2-way RTTY with all six continents and the BARTG Contest Manager receives contest logs from the operators in those six continents, a claim may be made for the WAC Award issued by the RTTY Journal. The necessary information will be sent on to the RTTY Journal who will issue the WAC Award free of charge.

RESULTS

RESULTS OF THE 1975 PACC CONTEST, sponsored by VERON of Nederland

This list shows the first place winners in each country/call area where certificates were awarded. An asterisk next to a score indicates a multi-operator entry.

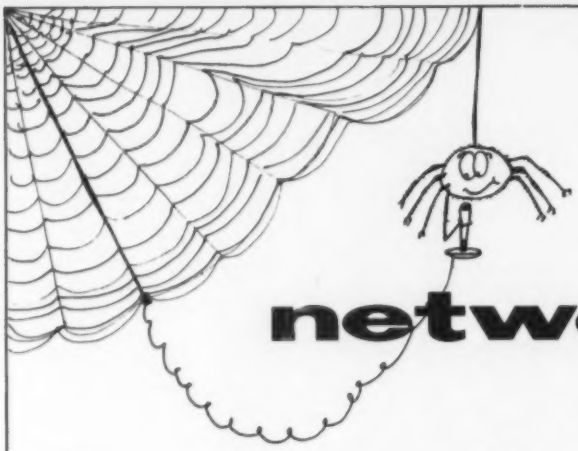
DL1OY	1155 points	W2EQK	1023 points
DM4ZXH	2331	WB4OGW	510
DM4JA	462*	W3ARK	240
EA5BS	4524	VE3EJK	162
G3ESF	4284	CQ7IZ	990
GM3KLA	5628	ZS6CS	3180
GW4DOO	540	UM8FM	336
HA5BP	5589	UL7GAA	90
I3BLF	1998	UH8BO	975
LZ1GX	9384	UD6BW	720
LZ2KSB	6885*	UK9YAR	600*
OH2LU	6231	UA9CBM	741
OK3ØKAG	5208	9H4G	90
OK3ØKFF	7227*	YU3DXU	510
OZ6DT	1080	YO4ASG	1155
SM7AIL	1728	UR2QD	4368
SP3IGB	570	UK2GAN	1890*
SQ1KKO	1581*	UQ2NU	90
UW6MP	2451	UK2PAF	9702*
UK3ABB	8370*	UP2OU	5265
UK2FAM	3312	UK5QBE	5913*
UB5ZAT	4104		

RESULTS OF THE 1975 BARTG VHF RTTY CONTEST

The top three positions in last year's VHF RTTY contest were obtained by:

1st	DC3OZ	82 points	12 QSO's	352 Km. longest QSO
2nd	DC8AM	67	13	297
3rd	DB1PA/P	65	9	291

There was a total of 21 entries with all contacts being made on 144 MHz.



networks

E.H. Barnett WBØIIX
Route 1
Ashland, Missouri 65010

NOTE: Times and Days are given in GMT.

NET TYPE	*Area*	*Net Type*	*Name*	*Time*	*Days*	*Freq*
I – Information	**NATIONAL**					
R – Rag Chew						
S – Service	Canada	T	Trans-Canada Net	1800	Sat	14130
T – Traffic	US	I	Mutual UFO Net	1800	Sun	14284
	REGIONAL					
	Mid US	T	Neb 160 Meter Wx Net	0130	Daily	1995
	New Eng	T	New England Barnyard Net	1200	M-S	3960
	East US	I	Mutual UFO Net	1200	Sat	7220
	Mid US	I	Mutual UFO Net	1300	Sat	3975
	Mid US	I	Mutual UFO Net	1400	Sat	7228
	Gulf Coast	I	West Gulf Hurricane Net	1605	Tu	7268
	STATEWIDE					
	GA	T	Georgia SSB Net	0000	Daily	3975
	CT	S	Connecticut Net	0200	Daily	3640
	IL	T	Central IL Net	1315	Sun	1815
	SC, NC	S	Carolinas Net	2200	Daily	3573
	GA	T	Georgia Training Net	2200	Daily	3718
	CT	S	Connecticut Net	2300	Daily	3640

My thanks to WA5RON for contributing this month. Does anyone know about a NASA Net? Keep those cards and letters coming.

Nets Worth Checking Into:

Mutual UFO Net. This net is for reporting and discussing unexplained phenomena. If you are a UFO buff check it out.

From page 4

letting off some steam. You could do worse things with your time.

MORE HELP NEEDED

Though we have a staff of 28 working on *73 Magazine*, we need one or two more and we need them badly. Our publishing of new books has been much slower than we've liked because we just don't have enough technical people to work on them. And our testing and work with microcomputers has been very slow since none of us know anywhere near as much as we should about them. We know they are going to be very big before long, but we need help to keep up with them.

If you have a good background in hamming . . . have worked with slow scan, RTTY, DXed a bit, built a lot, maybe written some articles . . . you might be missing a good bet for a place to work. If you have been playing with microcomputers, have built some of the interfaces, done programming in two or three languages, are able to explain to the average ham the difference between an assembler and a compiler, and have some articles to your credit, you could do worse than write to *73*.

73 is by far the most informal of all the hamrags to work for. We don't get as much work done at times, but we have a lot of fun . . . and there just isn't a better place to live in the whole country if you like relatively mild winters and summers, like to ski, camp, hike or things like that. New Hampshire is still a rare state for hamming and the mountains are fantastic for repeaters and UHF work. Peterborough is not far out of Boston, yet it is a country village nestled among the mountains, with three ski areas within a fifteen minute drive.

If you enjoy hamming, we're set up with a superb DX station on 20m, a fair Oscar 7 mode B setup, and all kinds of ham gear coming and going . . . RTTY, SSTV, FM, uP, you name it. The pay is geared to single people, not families.

Write.

HEATH BITES BITTER BULLET

As I understand the situation, Heath has recalled all of the HW-2026 synthesized transceivers. This is a move without precedent in the amateur field, to my memory.

The move could easily cost Heath well over half a million dollars, which is a very big number in the ham field. The rig sold for $289.95 in kit form (see page 100 of the January *73* Heath catalog) and Heath is offering to refund the original payment plus $25 if the kit has been partially assembled and $50 if it has been completed.

The problem was one that came as a surprise. It seems that there are some spurs coming out of the synthesizer which could in some areas of the country cause problems to other services . . . and this is on receive as well as transmit. Since the receiver was tested and okayed under Part 15 for such radiation the problem must be a very low level of spurious radiation. Extensive tests in the Michigan area by Heath amateurs turned up no problems, but difficulties began to arise when the units were put on the air in rf-congested areas such as New York City.

The first reaction, naturally, was to see what modification could be devised to cure the spurs. It turned out t be such a difficult mod due to the microparts involved that the half million dollar decision was made.

Bravo Heath!

In view of this situation, which has cropped up several times . . . I believe it was an amateur FM rig that brought on the FCC demand for all receivers to be put through Part 15 spurious emission tests . . . and with the problems encountered by at least two other synthesized rigs, it might be prudent for manufacturers to get prototypes checked out in a couple of major urban areas before releasing production runs in quantity. If manufacturers have any problem finding volunteers from among the field of waving hands I'll be much surprised.

TS-520 Specifications

MODES: USB, LSB, CW
POWER: 250 watts PEP input on SSB, 160 watts DC input on CW
ANTENNA IMPEDANCE: 50-75 Ohms, unbalanced
CARRIER SUPPRESSION: Better than –45 dB
UNWANTED SIDEBAND SUPPRESSION: Better than –40 dB
HARMONIC RADIATION: Better than –40 dB
AF RESPONSE: 400 to 2600 Hz (–6 dB)
AUDIO INPUT SENSITIVITY: 0.25μV for 10 dB (S+N)/N
SELECTIVITY: SSB 2.4 kHz (–6 dB), 4.4 kHz (–60 dB). CW 0.5 kHz (–6 dB), 1.5 kHz (–60 dB) (with accessory filter)
FREQUENCY STABILITY: 100 Hz per 30 minutes after warmup
IMAGE RATIO: Better than 50 dB
IF REJECTION: Better than 50 dB
TUBE & SEMICONDUCTOR COMPLEMENT: 3 tubes (2 x 6146B, 12BY7A), 1 IC, 18 FET, 44 transistors, 84 diodes
DIMENSIONS: 13.1" W x 5.9" H x 13.2" D
WEIGHT: 35.2 lbs.
SUGGESTED PRICE: $629.00

VFO-520

Provides high stability with precision gearing. Function switch provides any combination with the TS-520. Both are equipped with VFO indicators showing at a glance which VFO is being used. Connects with a single cable and obtains its power from the TS-520. Suggested price: $115.00.

SP-520

Although the TS-520 has a built-in speaker, the addition of the SP-520 provides improved tonal quality. A perfect match in both design and performance. Suggested price: $22.95.

So much for only $629!

Kenwood's TS-520 is a solidly built, superbly designed SSB transceiver that has literally taken the amateur world by storm. The value of its features and specifications are obvious. Less obvious, but just as important, is the kind of quality that Kenwood builds in. Hundreds of testimonials, in writing and on the air, attest to its performance and dependability. You probably have heard some of the same glowing praise.

The TS-520 operates SSB and CW on 80 through 10 meters and features built-in AC and 12VDC power supply. VOX, RIT, noise blanker, 2-position ALC, and double split frequency controlled operation are only some of its fine features.

Kenwood offers accessories guaranteed to add to the pleasure of owning the TS-520. The TV-502 transverter puts you on 2-meters the easy way. (It's completely compatible with the TS-520.) Simply plug it in and you're on the air. Two more units designed to match the TS-520 are the VFO-520 external VFO and the model SP-520 external speaker. All with Kenwood quality built in.

Available at select Kenwood dealers throughout the U.S.

Kenwood... pacesetter in amateur radio

TRIO-KENWOOD COMMUNICATIONS INC.

116 East Alondra / Gardena, California 90248

TV-502

TRANSMITTING/RECEIVING FREQUENCY: 144-145.7 MHz, 145.0-146.0 MHz (option).
INPUT/OUTPUT IF FREQUENCY: 28.0-29.7 MHz
TYPE OF EMISSION: SSB (A3J), CW (A1)
RATED OUTPUT: 8W (AC operation)
ANTENNA INPUT/OUTPUT IMPEDANCE: 50Ω
UNWANTED RADIATION: Less than –60 dB
RECEIVING SENSITIVITY: More than 1μV at S/N 10 dB
IMAGE RATIO: More than 60 dB
IF REJECTION: More than 60 dB
FREQUENCY STABILITY: Less than ±2.5 kHz during 1-60 min after power switch is ON and within 150 Hz (per 30 min) thereafter.
POWER CONSUMPTION: AC 220/120V, Transmission 50W max., Reception 12W max. DC 13.8V, Transmission 2A max., Reception 0.4A max.
POWER REQUIREMENT: AC 220/120V, DC 12-16V (standard voltage 13.8V)
SEMI-CONDUCTOR: FET 5, Transistor 15, Diode 10.
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Adventure

For a time, all the solid state surplusers were featuring returned or defective calculators that you could repair, with the instructions furnished. Some of the offers were absurd; the best I found was from Meshna, who offered an ac desk calculator for ten dollars, and a dc version for eleven. They were eight digit, and basic, without any radicals, reciprocals, factorials or such-like. Also, they used a liquid crystal display, which intrigued me. An instruction manual and a magazine reprint went with the deal. I ordered the ac model, with the dc as a substitute if it was out of stock. I got the dc version.

Anyone who goes for a deal like this just to save money is a hopeless romantic – or, at least, hopeless. Either you realize all the other benefits, or you are left holding the bag. I suppose that if you really failed to get the calculator working, Meshna would take it back – he's reliable – but eleven dollar junk is expensive, and an eleven dollar basic desk calculator, plus experience, is a bargain.

In due time I got my calculator, obviously brand new, all done up in a plastic bag. I opened it up and studied both the reprint – which was a discussion on repairing calculators, quite general – and the manual, which was an extract of the original, but with some omissions.

After studying this, I did what 90% of surplus buyers do – I got second thoughts and put it away for about three weeks. What was I doing with a busted calculator? If the manufacturer gave up, who was I to second-guess him? The fact that I have been troubleshooting all my life, some of it even digital stuff, made no difference. I felt like a fool.

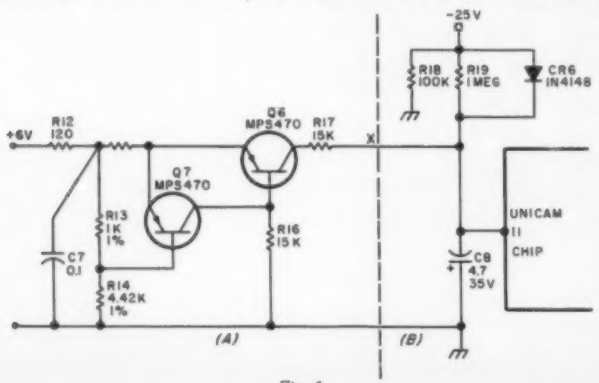

Fig. 1.

But this was clearly unproductive, and I got curious. I had to get a couple of Phillips screwdrivers, too, but I got her open. I saw two halves of a box, with a keyboard and circuit board in the top half, and the plastic light guide, bulb, and battery box in the other. Not much help. I put it together again, installed four D cells, slid the battery cover on, set the box right side up, and hit the "on" latch. The shade popped up, allowing the leaf switch to close, turning on the bulb, and I got light, but that was all. No numbers. Obviously the inverter, which I had read about, wasn't working. I knew you had to work the liquid crystal display on high voltage (comparatively) ac.

The moment of truth. Well, no use stretching it into an hour. I took the case apart again, but this time removed the circuit board and inverted it. My, my! Three big ICs; most of them look like dead cockroaches, but these, exceptionally flat, looked like millipedes. Two rows of legs on each side, an inner and an outer. And the display sticking up out of its connector. If you look closely, you can see the 8s all in a row, in transparent metal.

The rest is the usual peppering of electrolytics and plastic caps and resistors and transistors like canary-bird excrescences with a flat side, all the same size. And, oh yes! – a plastic spool of wire, must be L1.

And there it is. The spool is loose, vibrates a little. I pulled it away from the board, only the outer lead connected. The inner one was broken off. It had to be the inner one – Murphy's Law. All that agonizing and timidity and rationalization and I found the trouble without instruments, just by visual inspection, in 90 seconds! A good carpenter might have taken a minute and a half to find it.

It would not surprise me if each and every unit shipped had exactly the same trouble. In the first place, there is obviously some agreement with the manufacturer to keep the name confidential. It may be part of the deal to insert a defect, to justify the price. The price has to be justified to the buyer also. But the Post Office inspectors come around and maybe Ralph Nader, so instead of something the customer has to find with a triggered oscilloscope, a perfectly good unit with a deliberately broken inductor lead might be the best answer to the whole business. Now all this is my own idea – don't go asking the dealer about it. I could be wrong. But I'm pretty sure you won't get anything through the US mails that you can't fix pretty easily.

The inner conductor of L1? That's simple enough. I took a modeler's knife (they're sharp) and carved away part of the inner bottom edge of the plastic spool, and pulled out an eighth turn or so, and cleaned it. To fit, I needed a longer outer lead, so I unwound and retaped enough. Far less than half a turn all told, and no splices. I cleaned out the solder holes with a round toothpick and mounted the coil by them. Fixed.

Now when I turned it on, I got half a second of all 8s, then 0. The flyback converter was certainly working. The keyboard is like an organ with its long throw and light keys that seem to do nothing, but they do provide tactile feedback and I like them a lot better than those mushy things. The input is algebraic and serial, but non-repetitive. By accident I found that zero will clear under some conditions, though the C key should be used for this, of course.

Every calculator, even my little Novus 600 which has been roundly – and I think unjustly – criticized, has some particular talent, something it is particularly good at. It didn't take long to find the virtue in this one: It likes decimals. I would never again buy a six-digit calculator, but that is the only limitation I recognize in the Novus. This one has eight digits, which is one hundred times bigger, and I must say I haven't run out of numbers on it yet.

You can do nearly anything on a basic calculator that you can do on the newer fancier ones, which have keys for %, X^2, $\sqrt{X}$, X!, 1/X and such. It just takes longer – you have to work the gimmick as a separate problem and insert the answer as a factor. To take a reciprocal of 1.414 on the Novus, I can't just divide it into 1. It gives me a zero and sneers at me – I haven't left it enough room. So I have to enter 100 000 and divide that by 141, sorting out the decimals mentally. But this box – stick in a 1, divide 1.414 = 0.7072135 no strain. The liquid crystal display is odd – for one thing, it's bland, white, like cigarette smoke in a bottle. It's slow – you can see it go on and off, unlike the LED type. The driving circuit must look like wallpaper; you can't multiplex this type. The display has more leads going to it than you ever saw, like cattails in a swamp. Were I building one, I should never specify a liquid crystal – either LED or flourescent tube. But now I have this one, I like it, and its slowness doesn't bother me. It is by no means a limitation. For variety I may later dye the bulb with modeler's colored lacquer. You can get it in tiny 25¢ bottles.

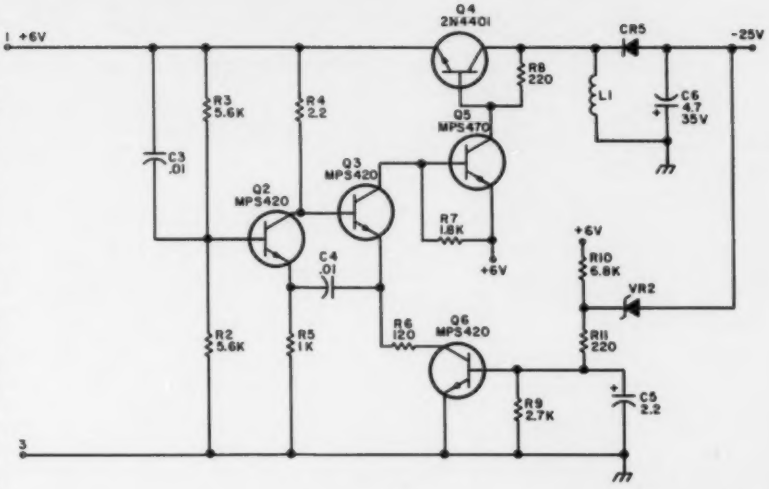

Fig. 2.

Now a "wild" trouble came in. The calculator still worked, but it didn't show "all 8s" when first turned on (see Fig. 1). I lifted off R17 to disable the low voltage cutoff (A) and checked out C8 with my VOM. I got a kick. Next I replaced R19 with another one meg without results.

I looked up the circuit in the manual and like Rumpelstiltskin, in the fairy story, you'd never guess his name. He is called a power-on-initialization circuit! Hot diggity zip!

Anyway, when negative 25 volts is first applied through R19, C8 is discharged and practically a dead short, so all the drop takes place across R19 and no voltage appears at terminal 11 on the CPU chip, which disables it and shows all 8s on the display. When the voltage rises with C8 charge, the 8s vanish and 0 appears, and you are ready to go. But I didn't get my all-8s-blink until I got up to 3.3 megs. But it seems that I had some pretty low voltage cells by that time, and later with good cells, 3.3 megs gave me a fifteen second wait. I went back to 1 meg and get five seconds, very nearly, which suits me fine. It has continued so without trouble.

Reconnected at X, Q7 and Q6 are a Schmitt trigger it says here. Looks like Q7 conducts when its base is above 4.0 volts, and cuts off Q6. Below 4 volts Q6 conducts, loading R19 and giving a permanent all 8s display. There may be a question about having two features on a single indication. But I'd miss the initialization (love that term!) and the low voltage cutoff is kind of fun, too. Now I have reason to believe that the calculator and display end will work on as little as two volts (!) with Fig. 1 disabled. Of course, the bulb won't light either, but the display can be read by light reflected off a white tablecloth. I *know* both will work with 4 V and that's a dead battery. The bulb is a 6 V 150 mA deal, and could be replaced with a 2 V 60 mil one and a 75 Ohm resistor. Less bright, and should serve OK. Could even put a filament rheostat in it – or switch out a couple of 20 Ohm sections. These are, however, sub-desperation measures, and by no means essential. You will get pretty good life as it is.

The long red plus lead from the switch broke off, and I put it back with the rest of the red ones. Even so it was wrong, and left the board permanently connected. When I corrected this, I read the drain to the board and was shocked to see 125 mA. The manual claimed much less than this. Would I now have to get out a CRO and measure pulse widths and frequencies and all that jazz? Not that I couldn't possibly do it; but it would be a pain in the neck for everybody concerned. When I put in new batteries, I measured it again: 50 mils! No, Ohm's Law still holds. The load is constant, relatively; the voltage is regulated and constant, so the power is constant. If input power is also constant, you need a lot more current when you have a lot less voltage; it is as simple as that.

Just in case, let's take a look at Fig. 2. It isn't easy to see any oscillatory circuit here, and I don't guarantee my own ideas. The manual is delightfully vague also, but here

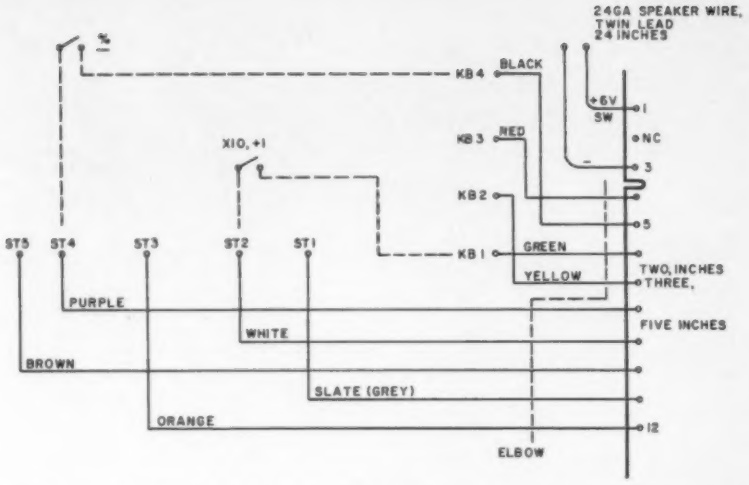

Fig. 3. KB-4 to term 4: 10 inch stranded #20 PVC elbow 3 inches from board, banded at board. STI-5: 10 inches, 5 inches to elbow, banded to switch near KB-1 for support. Colors shown original.

goes: Initially, plus six volts charges C3. The displacement current increases current in Q2 which lowers voltage through R4 to base of Q3. This reduces current and sends a negative-going pulse through C4 to emitter of Q2. This is the correct phase to aid the signal on the base of Q2, driving it to saturation. Once there nothing changes, so it drops down to cutoff and repeats, but without any help from the – primization? – circuit, C3 R2 R3. Note that there is no Q1. Q1 is the regulator in the ac version. Q5 is the driver, the only female in the bunch. Q6 is the series regulator, looks exactly like the others. When it conducts, it loads up L1 with flux, and when it cuts off – whoops! – high voltage, and pretty efficiently, too. CR5 rectifies, C6 filters.

VR2 breaks down at some specified voltage and lets in a pulse of negative which poisons the positive bias on the base of Q6 more or less. While dc at the base, the rest of the Q6 Q3 Q5 circuit has no frequency limitation. If I missed anything here, write me; that way we all benefit.

Now let us look at Fig. 3. When you first open up the calculator, the little green and red and yellow wires look very pretty. You get the first three openings free, then they begin to break off, spoing! – singly, in thirds, triads, and diminished sevenths. You can learn to hate them cordially in short order. The wires are simply not made for servicing. While not actually "banjo" they are pretty short. I have indicated the colors on the drawing so you will know where to replace them until you can get more wire, but I earnestly recommend something like the #20 stranded PVC and the 24 gauge speaker wire (twinlead) which I used.

You can make a game of it while you are waiting to get the wire – try to determine, from the diagram, and from missing functions, which wires are broken. The keyboard is a scanning type – the ST numbers along the front apron *mean* strobe, while the KB up the right edge (keyboard inverted, of course) are keyboard buses. The number of individual functions available on these keyboards depends on the number of crosspoints. On a four by five layout like this one, there should be twenty, of course. This has, in fact, only seventeen.

An eighteenth is provided for and indicated on the drawing, but there is no crosspoint keyed for it. This is the missing key between ST4 and KB4, and is a % function. I have little use for such a function, but it gripes me to have no access to the capability, so I added a little red push-button next to the "on" shade-latch where there is room for a dozen, maybe less. I have an OAK calculator switch button, but it is a sub-surface mount. I wanted to put it in a blank space between switch and panel, but the present keyswitch assembly is so big there isn't any room. Top mounted, the OAK would look like a lily on a stem and the hell with it. The little red button isn't half bad.

Works, too. Starting with 88888888. one tap gives 888888.88 then 8888.8888 then 88.888888 then 0.8888888 then 0.0088888 then 0.0000888 then 0.0000008 and one more press gives 0. You have to use a firm deliberate pressure, any jitter will give you a double function. The long throw of the regular keys minimizes this. In use, you set up the problem and punch the % instead of the = and you're done.

I've known for some time that some chips have capabilities that are not used in the calculators, to provide for next year's features with a standard chip. This spreads development costs over several years and saves money all around, a desirable conclusion. So I went prospecting on this one. What else was hidden?

KB1 and ST4 crosspoints give an equals function, but we already have that on another key. KB1 and ST2 are something else again. This crosspoint multiplies by ten, then adds one. If you had 87 in the register and operated this crosspoint, you would get 871.

Useless as a tire pump? For normal calculations, yes. But if you equip your calculator for % with an extra keyswitch, leave the leads a bit long so that they will reach this last crosspoint. Then, at need, you can move the leads as necessary. Might turn out to be the best and most useful function the thing has got.

Every family has its wise guy, often a brother-in-law. Tell him about the calculator you fixed. He will sneer, as usual. Show him all the features, let him try it, but make no reference to the little red button. He will discover that it multiplies by ten and then adds one to what is in the register. He will sneer again.

Ask him if he knows how mathematical wizards perform mental feats such as the extraction of any roots of large numbers. What do they use factorials for? If you ask a mathematician what a X 10 + 1 function or constant would be for, they would just look at you. (This is truth, in my experience. Ask them almost *anything* and they'll just look at you. I asked the head programmer for Ma Bell what was meant by "an order of magnitude" and I got the wordless look. They're bright people – it's just when you surprise them with an intelligent mathematical question their brains de-clutch.)

Further, you can claim harassment from the CIA who are after a cypher key – like the Playfair, but completely random and longer than the message, in the modern fashion. This is hidden in the memory of the machine, which was then marketed by mistake, and the X 10 + 1 key will retrieve this when properly used. If you can fix a computer (calculator), you can generate an even gaudier lie than this. Go to it – now is your chance to get even with the – !

To get back to the wiring, two feet of the battery lead is nice. The original lead was always catching on the leaf-switch, and draping over the light guide so that it would appear behind the numbers in a most distracting manner. Now, no trouble at all. It goes on #1 and 3 of the card (between the slots); watch the polarity. No tying was used.

The KB leads were the shortest, banded (tied) together near the board terminals for mutual support. They were not tied to the board. The ST leads were formed into their own separate bunch, joining the KBs only at the edge of the board. Originally it was planned to poke the leads between circuit board and keyswitch, but there simply is not enough clearance. But the board is set back a little, making a front porch of the ST terminal strip. Putting elbows in the bunches

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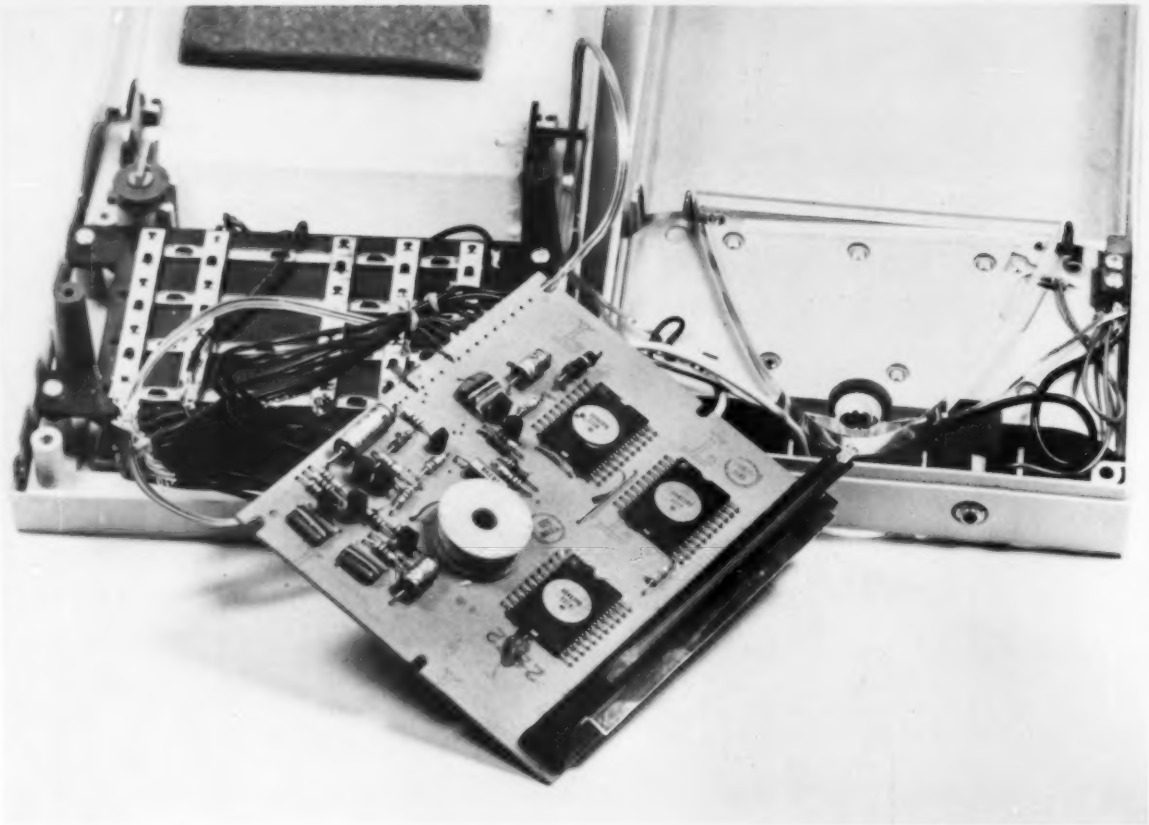


of wires and folding them and dressing them to clear is simple and quick, and that cabling is good for as many times as I want to open the box.

Now that you know what we're talking about, the photograph will explain more of the details. The top and bottom and the removed board were all jammed together to get as much detail as possible in the photograph, but when actually working on the thing, you would have the cabling stretched out, top and bottom halves well spaced with the board on edge, or even flat, between them. It sure beats the original wiring.

The light guide is interesting to the optical students. You get such a perfect field that you don't even notice it, but try to get projection like that with lenses you can afford! The plastic is Lucite, cast, with locating bosses, and a two-side-sticky tape mounting that has given me no trouble so far. The shape is near-parabolic, with the light bulb near one focus. You get total refraction along the curved edges, and straight out the straight far side. Cheap, effective, and plenty hard to duplicate by any other means. The bulb socket is held on a boss by a spring wire clamp that has one leg up, one down. You can grab the up leg in "flats" (pliers, long-nose) and adjust it readily.

R19 is that big ¼ Watt 1 meg jobbie on the board. The original 1/8 or whatever went haywire and changed its resistance, as they sometimes do. You never know if they will go up or down, and this one went down. All you can get is one quarters, so I bent the leads under the body to the correct spacing. It fit nicely.

Now is the time to say something nice about the circuit board. It is opaque, like wallboard, and thick. The thing is one-sided, and the conductors swirl all around to avoid crossovers. It is lacquered green, and the swirling patterns look like big thumbprints in green paint. The whole thing looks a bit on the crude side, especially after working on fibreglass high frequency types.

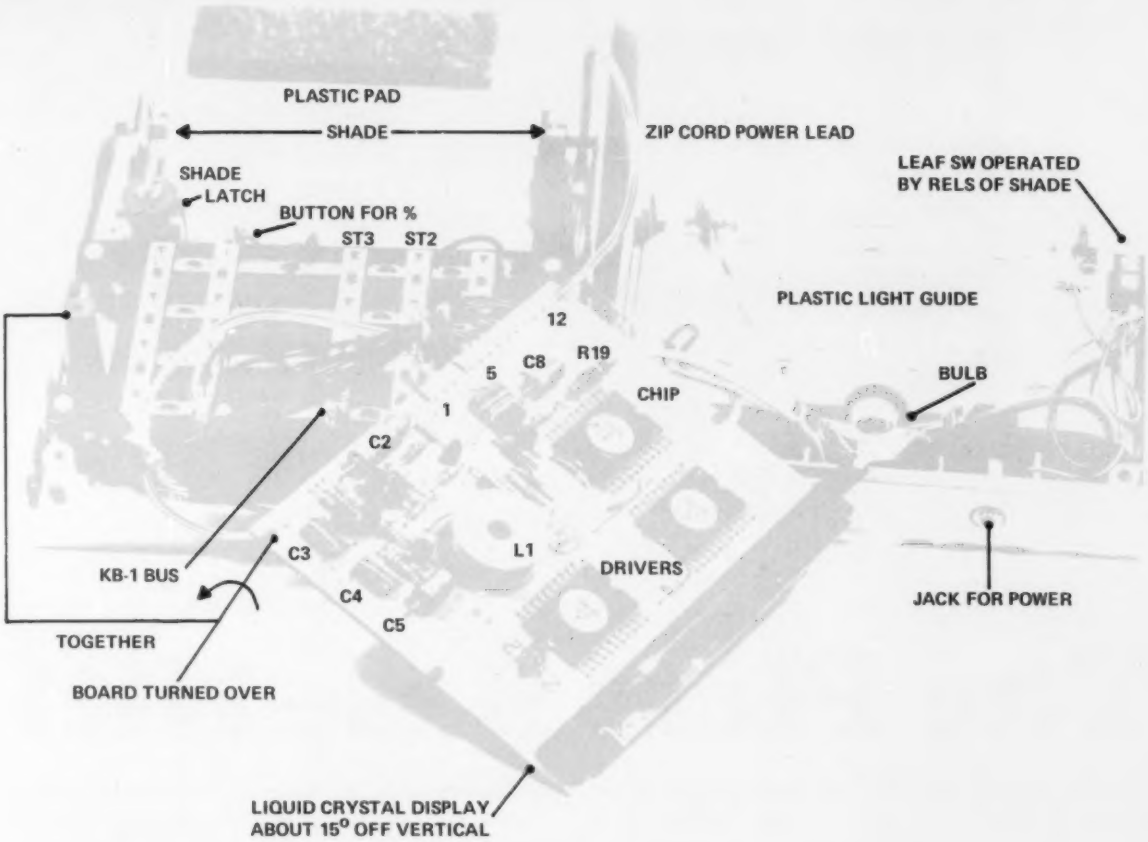
But whoever specified this board knew what he was about. There's copper there, and it is cemented on to stay, and the lacquer helps prevent solder bridges. To work on a board like that is to appreciate it. Remember that I cleaned and replaced all the damned little pretty-colored wires many times, I had the R17 up and down like a pump handle, and I replaced an eighth Watt resistor with a quarter Watt one – no trouble at all. Nothing blistered, nothing came loose. True, I have worked on printed circuits before, I was using a small iron, I was using "microwave soldering technique" and I never let myself forget that it *was* a circuit board I was working on. Nevertheless, I didn't baby it, and if you can be trusted with any board, or indeed, with any modern kit, you'll have fun with this one. It's good stuff.

The case – neat but not gaudy. Green-top keys, egg-shell white case. I don't think it is any hi-impact plastic. I think it is the good old Styrene plastic, easy to break, easy to burn, easy to melt, and easy to carve. Drills easy, too. The chaff, or chad, or sawdust, or whatever becomes highly charged and wants to get on the screen where you don't want it. Try the sticky side of Scotch tape (C) to swab it up. Get it all if you can.

The thing is held together with self-tapping screws. Don't lose any, because these are long and skinny and you may not find the sizes. They seem to be double-threaded – if they don't screw in well, back out a half turn and try again. If still not, swap with the other of the same pair. Makes a surprising difference.

There is no number or logo on the calculator. The book says ACCUMATIC E630 and gives a parts list, but who can you buy parts from?

Following some tenuous indications, I called Rapid Data Systems, Toronto Office, 129 Carlingview Drive, Rexdale, Ontario. Their number is 416-678-1000 and they referred me to an agency in the States: Calculator Service, 29245 Stephenson High-



way, Madison Heights, Michigan. Their number is 313-399-4300. They were unable to identify the model, thinking it must be a prototype (come *on*, a production run of *prototypes?*). I asked about the Liquid Crystal Display RA-90009 and he gave a corresponding number #1930801-1 which was priced in single units at $15. So much for the economics.

Meshna advertised his two types of calculators in several flyers, a couple of issues of magazines and at least one catalog. He no longer advertises them, and for a good reason – his stock is running low. A lot of guys will buy them and put them away for a time, as I did, and some will continue to order from old catalogs or ads, so sales will slow down but not cease.

On November 14th, Meshna told me he had 200 units in stock. I don't know how many he has at this writing. If you want one, order as soon as you read this. There are other data I'd like to include in this essay, but there simply isn't time to get it up – you have all you really need, anyway, so here goes for the Post Office. Happy initialization! ■

Thought you might be interested in hearing about my recent Oscar 6 contacts with ZK1DX. This took a couple of months to set up and accomplish. To date we have made 3 contacts via Oscar 6; they were direct with no Tropo assist. If you study the distance involved you will find our range overlay to be approx. 300 mi. max. Our communications "window" is 30-45 seconds max. Rarotonga is located on the 20th parallel south of the equator; this all makes for a very interesting 2 way contact.

Wyn ZK1DX uses 80 W out and an 11 element yagi. Equipment here is Echo II and amp 80 W out, to a pair of stacked 9 element yagis with az-el control at 50. Receiver is a Kenwood R599 and Westcom Noise blanker and preamp and 3 element yagi.

I also managed to get a good tape of our last SSB QSO.

Enjoy your column.

Bob Findlay W6NZX/W7KMC
Vista CA

AMATEURS ACCESS COMPUTER VIA SATELLITE

On October 9, 1975, two radio amateurs made the first claimed remote access of a computer not only by means of a two way radio link, but also through a communications relay satellite.

This milestone was initiated by W. Franklin Mitchell Jr. operator of amateur radio station WB4BWK in Due West, South Carolina, when he transmitted an "execute program" command to a Mod 8 microcomputer located at amateur radio station VE2BYG/3 operated by Randall S. Smith in Barrie, Ontario, Canada. Randy has since changed his callsign and is now known as VE3SAT.

Randy's microcomputer received the command relayed by means of the AMSAT-OSCAR 7 satellite and executed the stored program, transmitting a preset message from VE2BYG/3 to WB4BWK. The data was transmitted in ASCII code at a rate of 110 Baud. The Federal Communications Commission has granted a waiver to radio amateurs interested in computers and radio teletype allowing them to transmit ASCII coded information through the satellite.

Both Randy Smith and Frank Mitchell are members of AMSAT, a nonprofit worldwide organization of radio amateurs based in the Washington DC area.

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by
Stirling M. Olberg W1SNN
19 Loretta Road
Waltham MA 02154

Tunable FM Receiver Strips

Almost all surplus land mobile service receiver strips which find their way into the amateur service are dual conversion crystal controlled systems. The primary frequency selection used in the first conversion is a crystal bank which usually costs more than the receiver. These crystals are required to perform at close tolerances which previously were of little concern to the amateur unless he worked at band edges or nets. In order to have use of all available frequencies, the operator must either pay the price of many crystals or install fairly expensive frequency synthesizers. There is another way. Some thought and experimentation at W1SNN produced additional frequencies as well as a snooping oscillator which allows the receiver to be tunable over a very narrow range and keep the stability and close tolerance frequency control. Let's take a look at the block diagram, Fig. 1. The diagram indicates the approximate configuration of two well known receiver types, a Motorola Sensicon and the General Electric Progress Line strip.

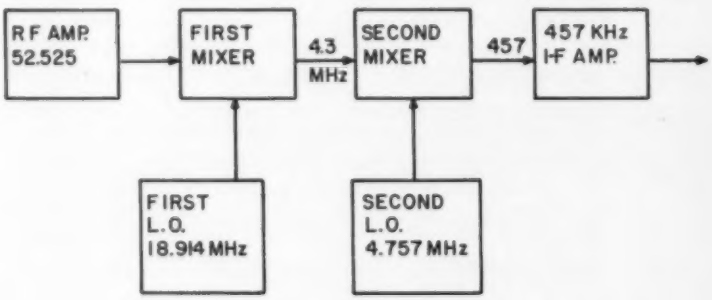

Fig. 1.

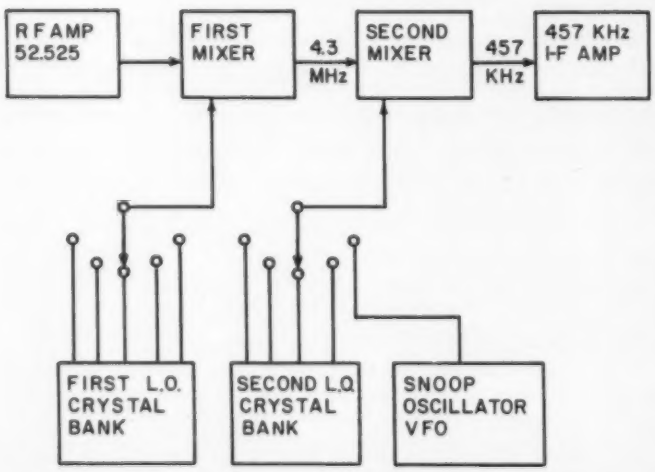

Fig. 2.

The input and output circuits of the rf amplifier and the first mixer have double tuned critically coupled circuitry which reduces the effects of nearby transmitter desensitization among other things. Similar circuitry is used as the output of the first mixer and is carried even further to the input and output of the second converter. For this reason these receivers have a limited range of acceptance for which they can be used without retuning. This is about ±50 kHz. By stagger tuning this can be extended without the danger of desensitization. If the station is far enough away from other transmitters, this is, of course, not too serious a problem.

The reason I went into such detail in the above paragraph is because herein lies the method of adding additional frequency control, at surplus crystal prices, and of adding the snoop oscillator. The quickest way you can move around your existing crystal control frequencies is to change the operating frequency of the second local oscillator crystal. But before we change anything, let's take a careful look at how the local oscillators and i-f frequencies work to produce an operating frequency of 52.525 MHz. A Motorola Sensicon Receiver strip will be used.

According to the manufacturer, the first conversion crystal frequency should be calculated thus:

$$f_o = \frac{f_c + 4.3}{3}$$

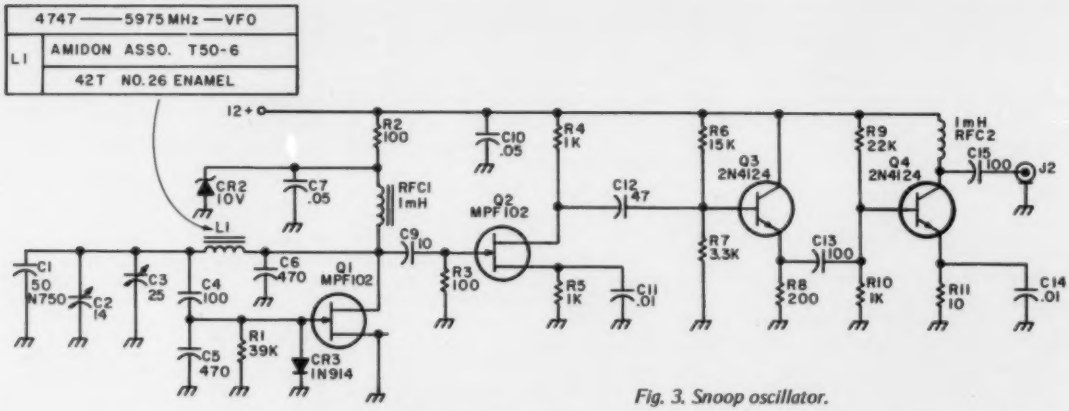

Fig. 3. Snoop oscillator.

where:
f_o = the operating frequency
f_c = crystal frequency
4.3 = second conversion i-f
Therefore, for a crystal to operate on the receiver on 52.525 MHz . . .

$$\frac{52.525 + 4.3}{3} = 18.9416 \text{ MHz}$$

Now to get the second conversion crystal to an i-f frequency of 457 kHz, a 4757 kHz crystal is used in the second local oscillator and is calculated thus:

$$f_{2n} \text{ conversion} = f_{2c} + f_{2i\text{-}f} \text{ or } 4.3 + 457 = 4757 \text{ kHz}$$

Now let us dip into our sacred junk box, and lo and behold, there is that crystal you have saved from a chunk of surplus. It has a frequency of 18.930 marked on the can and it is a fundamental crystal with the right pin spacing. So let's stick these numbers into the first equation and see where we end up. It comes out twenty kHz low, you say. Well now, if you add that 20 kHz to the second LO crystal and make it 4797 kHz, the second formula will show the correct i-f difference of 475 kHz and the first formula will show that we are on 52.525 MHz. So now you say, "Well, I have to buy the second crystal." Right, you do, but look at the surplus lists and see the nice low price.

One word of caution: Remember that the crystals used must be chosen to look into a 32 pF load and that there are many that use a lower capacitance load and the frequency will come out somewhat different than calculated. This can, in most cases, be taken care of with a frequency trimming capacitor.

All of the foregoing may sound like some kind of "hocus pocus" but be assured it is not. The manufacturers of these two strips and many others describe the same techniques for "exact frequency tuning," and although it is not as extensive a frequency excursion, it is done in the same way.

Now observe the second block diagram, Fig. 2. The crystal banks shown are substituted with a logic oscillator[1] allowing the operator to switch at will to whatever frequency he chooses to generate. Also there is a vfo unit shown which can be switched into the second crystal oscillator grid. Now you have a snoop oscillator which allows you to tune around the very narrow bandpass and listen to what is going on in between the channels.

The crystal oscillators shown are the same as the original logic oscillator. The changes are to improve the original circuit which used TTL logic blocks; the new circuit uses CMOS logic. The noise immunity of these units allows a less stringent power supply source regulation and in our case allows the use of a simple zener diode regulator coupled to the main supply voltage through appropriate voltage dividing resistors.

Crystals used in this oscillator must be fundamental types. The circuit has been used with crystals up to 20 MHz and I am sure if I had higher fundamental rocks it might go to 25 MHz before the logic block would start to react sort of funny. The circuit shown is in use at W1SNN for the six meter FM band. On two meters the addition of a frequency multiplier will provide the correct harmonic before it is fed into the crystal jack.

The circuit of the vfo was taken from the article in November, 1973, *Ham Radio.*[2] It is the very stable Vacker Oscillator which was used as a twenty meter vfo. The frequency has been changed to suit the Motorola and General Electric Progress line receiver strips. It is shown as it was modified for this application. It would be a good idea to review the article described and use the construction practices used by that author. This unit has been mounted in a nice cabinet and the output fed through a six foot coaxial cable to the oscillator jacks. The output of the snoop oscillator is brought out through a coax jack as indicated. A length of coax up to about eight feet long can be used and therefore only the new crystal bank and the snoop oscillator need be stationed at the operating position.

The second local oscillators for either the Sensicon or the Progress Line strips are fed into the grid side of the crystal socket or directly to the grid of V5 pin 6 on the Motorola or to pin 7 of V319 of the General Electric receivers. Although no modification

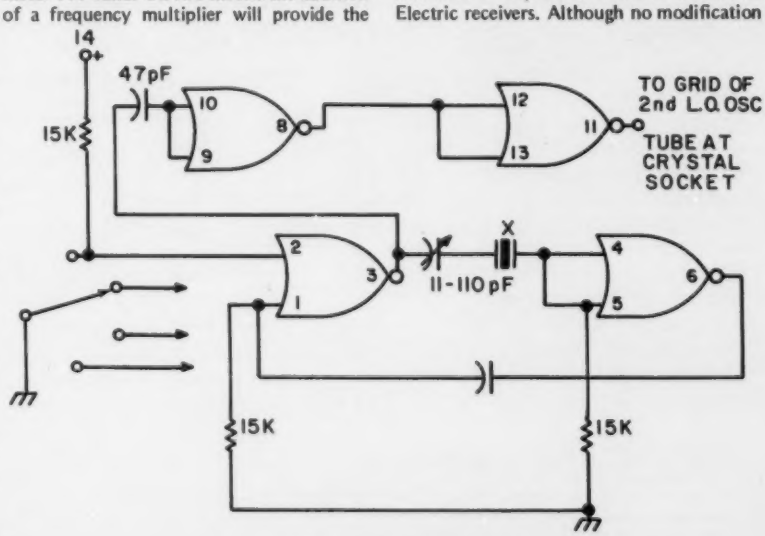

Fig. 4. CMOS oscillator.

of either receiver is required for this adaptation, it would be wise to have the receivers working before trying these stunts. I modified a crystal can head by unsoldering the can, removing the contents, then drilling a hole in the can top to allow passage of the coax through, then soldering on the coax leads to the pins in the header. Reassemble the can to the header and now you have a plug which will fit directly in the crystal socket. Make sure that ground goes to ground and so forth . . . or it won't work.

The same procedure as has been described for six meter receivers can be applied to any of the high band strips which are first converted to two meters. In our case we used another Sensicon Strip PA 9033, and after it was set up and working the vfo — crystal bank was plugged in and away we went. In the above mentioned receiver, the second conversion mixer is a pentagrid converter which also serves as the second LO. To use the adaptations described, the receiver should have this minor addition or my name will be changed by many of you. It is done thus: Locate the second mixer tube, a 6BE6 designated V6 in the circuit diagrams found in the instruction books, disconnect the wire which runs from the crystal socket X-19 to pin 6 of V6, and ground this wire. If this procedure is not followed, plugging in the vfo as described in the prior paragraphs will ground pin 6 and part of the B+ line and create my new handle.

It is hoped that these ideas will be of some use to other amateurs who enjoy using what they have and modifying circuits to achieve an inexpensive adjunct to their stations. ■

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[1] "The Logic Oscillator," Stirling M. Olberg W1SNN, June, 1973, *Ham Radio.*

[2] "Low Power Solid State vfo Transmitter For Twenty Meters," C. Edward Galbreath W3QBO, November, 1973, *Ham Radio.*

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FM Schematics Digest, A Collection of Motorola Schematics, Sherman Wolf, Boston, Massachusetts.

Motorola Service Manual 54P802495-0, Motorola Communications.

General Electric Co., Progress Line Instruction Book #LBI-3002E, General Electric Co., Mobile Radio Department, Mountain View Road, Lynchburg VA 24502.

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by
John J. Risch WØFEV
3508 Whispering Woods Dr.
Florissant MO 63031

Surplus Circuit Boards — A Gold Mine of Parts

Surplus circuit boards are currently available which contain many parts of value to "home builders" and experimenters. Many builders pass these by for two reasons: One is that the parts are too difficult to remove, and the other is that they probably don't realize what actually is available. Several articles have been written on various methods for removal of these parts, from unsoldering them using a "solder sipper" and special tips (which usually damages the component), to submerging the components in a tray of water and unsoldering (very unsatisfactory), to fracturing the board from around the part (this ruins the board). Offered here is a method of recovering parts without damage, and with a minimum of effort, and which leaves the board in usable condition.

To remove diodes and transistors, closely examine the board to determine how the leads are bent over. Carefully force a small screwdriver under the lead through the solder blob (I use a jeweler's screwdriver), and "dig" out the lead clear of the solder or break the lead and solder blob free from the surface of the board. (See Fig. 1.) Then, using a pair of long nose pliers, carefully pinch the solder blob (if it was lifted from the board) to crack it. (See Fig. 2.) In either case, the next step is important. For transistors, carefully pry the transistor off of the circuit board with a small screwdriver, exerting even pressure at several places around the case where it contacts the board. (See Fig. 3.) After removal, excess solder can be crushed off the lead with the long nose pliers.

To remove diodes, after processing as above, carefully lift the lead (on the component side of the board) with small pliers and gently "tease" (pull) it free or slip a screwdriver between the lead and the board and gently lift it off.

Resistors and other components which can be slightly heated may be removed in a similar manner, but the solder blob should first be removed by heating with a soldering iron. While the blob is soft, gently strike the edge of the board on a hard surface to remove the molten solder; the lead can then be pried up as described above.

Power transistors pose a special problem, but by using the screwdriver method, the (usually large) solder blob can be flaked away and reduced in size so the component can be pried off without damage. If on your first attempt you break a lead and ruin a transistor or two, don't be discouraged — soon you will learn just the right amount of pressure to exert.

Extra caution is required when prying the lead up from the solder blob. Number one: *Point the screwdriver in such a manner that if it slips it won't gouge your hand or leg or other body parts.* Second: Do not use too much pressure or else you may shear the lead. Third: Take your time.

Transformers and other items mounted by rigid leads may be removed by first "digging" away as much of the solder as practical, then prying the component off with a screwdriver while heating the solder blob with a soldering iron (do not overheat). After the components are removed, the board may be further processed by removing the printed circuitry with a coarse rasp and finishing off with sandpaper to remove any remaining copper. An X-acto knife may be used, with caution, to remove solder and copper from the board.

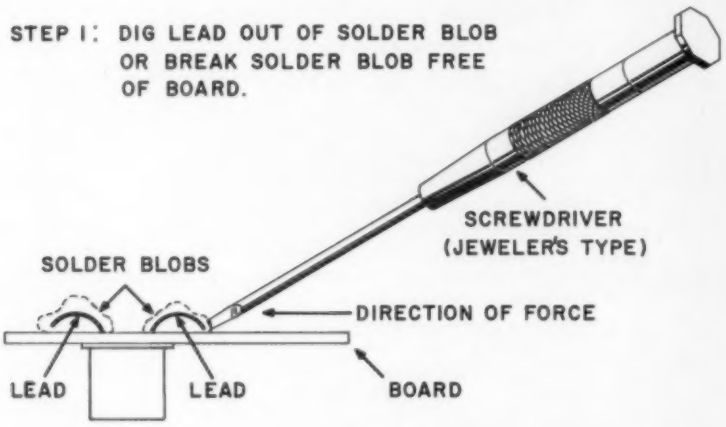

Fig. 1.

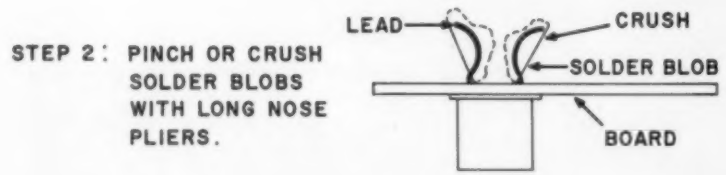

Fig. 2.

The following components have been successfully removed from the popular 8 for $1.00 boards being offered by "Radio Shack" and other parts houses:

Transistors: Both germanium and silicon, PNP and NPN types, including "power types," usable up to 60 MHz (by actual test). Many may go much higher.

Diodes: Both germanium and silicon, glass and plastic types, including zeners.

Resistors: 1/4 and 1/8 Watt 5% tolerance, conventional types and many precision 1% tolerance types, various ranges.

Capacitors: Silver mica, and tubular ceramic types, various ranges.

Inductors: Molded plastic types, all marked with inductance rating in uH.

Electrolytic Capacitors: Tantalum types, 5 to 200 uF in voltage range of 10 to 50 volts.

Transformers: Molded plastic case, various ratings, marked with diagram.

Relays: Dry reed types, NO and NC types, 3000 to 7000 Ohms dc resistance, which close or open at 5 through 10 mA.

Crystals: 1000 kHz precision units.

Trimpots: Precision potentiometers, screwdriver adjust.

Heat sinks: Finned types, aluminum.

Chokes: Molded plastic, iron or ferrite core types, all marked with inductance rating.

Rectifiers: Marked with manufacturer's number; used and tested up to 110 V RMS.

Others: Several unidentified components which appear to be "Darlington" types of transistors and some possible high current diodes (zeners?).

Circuit Boards: Various compositions, laminated phenolic, fiberglass, etc.

All of the above were removed in good condition and were usable in home construction projects. Since using this method, I have not had to buy blank circuit boards, resistors, electrolytic capacitors, transistors, diodes, etc., for several months.

When selecting these boards (if you make a "hand" selection), try to select those with the parts you need most, and watch for those where transistors are mounted away from the board by small teflon or nylon pads. These give longer lead lengths. Please test all components with a transistor tester or ohmmeter before using, for some may be bad, due to the fact the circuit board was "discarded." To date, however, I have not yet encountered a bad component. In most cases the lead lengths are sufficient to allow full usage of all components; a clamp-on type heat sink may be required, when remounting some diodes and transistors.

This method is also useful when repairing small radios, tape recorders, and circuit boards in general when it is necessary to replace a component. ■

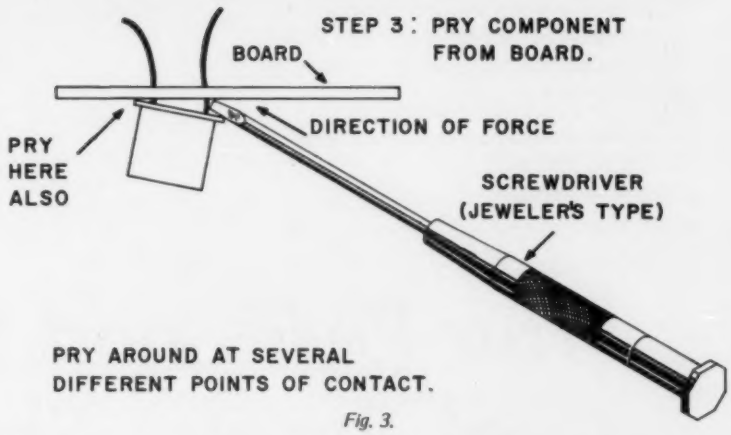
STEP 3: PRY COMPONENT FROM BOARD.
BOARD
DIRECTION OF FORCE
PRY HERE ALSO
SCREWDRIVER (JEWELER'S TYPE)
PRY AROUND AT SEVERAL DIFFERENT POINTS OF CONTACT.

Fig. 3.

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by
Brad Thompson
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The Perils and Pleasures of Surplus Shopping

Everyone likes a bargain, especially with today's prices soaring to new heights. Ham radio can be an expensive hobby even to the ham who home brews his own equipment. A visit to your local electronics supermarket will confirm this, just as a visit to the other kind of supermarket shows where most of the paycheck goes.

One's thoughts naturally turn to getting things for less money. In many cities, bakeries have thrift outlets where out-dated baked goods are sold at substantial savings. Of course, it pays to peer through the wrappers for any trace of mold just in case the baker cut the final sale date a little too close.

The electronics industry has its own versions of the bakery outlets, the traditional electronic surplus outlets which can be found near most major American cities. You can make some excellent buys there, but you can also get stuck with the electronic equivalent of moldy bread if you're not careful.

Let's review a few of the perils and pleasures of buying surplus electronics. Although every transaction is unique, a few general types of situation emerge repeatedly. This list, by no means exhaustive, applies in general to both mail order and eyeball-to-eyeball purchases:

The Inadvertent Burn
The Deliberate Burn
The Speculative Plunge
The White Elephant
The Outright Disaster
The Home-wrecker
The Unpleasant Surprise
The Submerged Surprise
The Pleasant Surprise

The Inadvertent Burn

A post-purchase discovery that what you see is not necessarily what you get. This is an especially common occurrence when a part's function isn't immediately obvious. Back in the old days, big chunks of filament rolling around inside a tube's envelope were a dead giveaway. But have you ever heard a 709 op amp rattle? (A friend of mine has, but that's another story.)

Your friendly neighborhood surplus dealer will often correct an Inadvertent Burn, especially if you ask him politely. Remember, it may not be his fault. But if your purchase was a one-of-a-kind, last-one-on-the-shelf item, you'll have to renegotiate the transaction and settle for something you can't really use. Cash refunds are possible – it doesn't hurt to ask.

The Deliberate Burn

If your surplus dealer does this to you, drop him. Fast. Even if his shop is loaded with cheap, mouth-watering goodies. You have enough hassles of this variety in your life as it is, what with unscrupulous used car salesmen and government officials. Write to your local consumer protection agency and describe what happened; they may be able to help you recover your money. Your letter may be the capstone to a case they have in preparation, which could result in lots of people recovering their money.

The Speculative Plunge

It's not always the dealer's fault. You can be hoisted with your own petard, as the old saying goes. For instance, that bag of 0.1 Ohm wirewound resistors is a real bargain, especially if you decide to build that power supply which uses a 0.1 Ohm current sensing resistor. But do you *really* need 221 of them? Still . . .it's only a buck . . .

The White Elephant

A variant on the Speculative Plunge which involves a piece of equipment rather than a component.

I once bought an elderly tube-type frequency counter from a leasing company which was cleaning out its warehouse. At $25.00 the counter seemed to be an excellent buy as it was in working condition and bore few of the scars usually acquired by leased equipment. Surplus ads in various magazines were listing the counter at $150.00, and my thought was, "Wow! I can run the counter for a year, sell it to someone for $50.00, and make some money."

Last month, I took the counter to a ham auction and watched in dismay as a bored bidder took it away – no, stole it! – for $4.00! Here's what went wrong: First, there were no surplus dealers interested in it at *any* price. One dealer I attempted to sell it to wouldn't take it because he had ten more in his warehouse.

"Sure, my catalog price is $100.00, and if I ever find just *one* customer at that price, I'll break even. What? You want I should pay you $50.00 for yours? Gettoutaheah, kid!"

Secondly, the counter was obsolete. Inside that pristine grey case lived at least 36

hungry little tubes and a cooling fan which could have doubled as propeller for a B-29. And at 300 Watts or so, it *needed* that fan. Even worse, the counter would count only to 100 kHz – it was designed that way. If you goosed the input signal up a lot, it might count to 120 kHz, but only if it felt happy that day. It was fine for audio work, but most counter users need some rf capability.

The moral to this story is clear: Make sure that whatever you buy has long-term value to *you* and forget about making a profit unless you're prepared to learn by trial and possibly expensive error. Leave the speculation to the pros and your friend down the block who has a rich and generous uncle. A footnote: A friend of mine just called with the news that we (he stressed the *we* part) have a chance to buy a whole trailerload of World War II radar equipment for only $500.00 . . . we're going to look at it this afternoon . . .

The Outright Disaster

I once purchased a surplus ZM-11/U RLC bridge for only $5.00 thinking that I was getting a bargain. The surplus dealer obligingly let me apply power to the unit and we both watched the magic-eye indicator tube warm up to a healthy looking green glow.

The dealer scrounged around behind the counter and came up with a precision resistor. I connected the resistor to the terminals, switched the function selector to "Ohms," and adjusted the main dial for balance. Lo and behold, the dial and resistor values agreed! "Fine – I'll take it," I said, and went home happily.

Later that evening, I located my standard capacitor and confidently hooked it to the bridge's terminals. I selected the appropriate function, set the test voltage and confidently twisted the balance dial. Nothing happened.

I tried another capacitor, then another, and then some inductors. Still nothing. Frantically, I grabbed a resistor at random from the bench. Again, nothing. By now, I was aggravated. I located another resistor in the same range as the dealer's test resistor and sure enough, it worked.

I unplugged the bridge and reached for a screwdriver. Five minutes later, I was staring at a surplus hound's nightmare. Some misguided individual had attempted to dismantle the bridge (for service, perhaps?) by snipping the many wires which run from deck to deck in this compact instrument. Just for variety, he had thrown in a few solder splashes and odd pieces of hardware. Several freshly-cooked resistors stood out like sore thumbs. I wanted to throw up.

Anyhow, if you should happen to get an Outright Disaster, cheer up. You've plenty of company out there.

The Home-wrecker

This type of surplus purchase is a possible consequence of buying an unrecognized White Elephant. A variation is the bargain-priced, completely useful goody which just happens to be a bit too ugly or dirty to win the acceptance of one's mate or parent.

Once in my youth, I proudly dragged home a pair of vintage BC-375 tuning units in their original packing. I had done well: In a three-cornered trade involving an old Stromberg-Carlson console radio, a half dozen tired 807s, and several hundred baseball cards which included my prized Ted Williams card, I had emerged clearly on top. My friends thought so too, including the former owner of the tuning units who had worried about unloading them before the dampness in his basement caused any damage. If it had, he assured me, we could reverse the trade.

I balanced the boxed-up tuning units on the handle-bars of my battered Schwinn and walked the bike all four blocks home. The rays of the summer sun beat down on me, the bicycle and the tuning units. I began to notice that the boxes smelled slightly of mildew, but thought nothing of it.

I reached home, carried the cardboard boxes downstairs into my basement workshop and proceeded to joyously unpack the tuning units. In minutes, the basement floor was littered with packing material and the tuning units were on the bench. The smell of mildew was quite a bit stronger now as it mingled with the familiar "surplusy" odor of the fungus-proofed tuning units.

By then, it was time to do my paper route and I left. I returned two hours later to find my precious tuning units and all the packing material exposed to the elements in the back yard.

My mother, who is a painstaking housekeeper, was very angry. "Keep that horrible smelly stuff out of the basement! Don't you *dare* bring it into this house until it's had a chance to air out!"

I tried vainly to explain that, if I kept the tuning units outdoors, they would corrode, but she didn't budge. Finally, we compromised on a quarantine period where the tuning units would be allowed to decontaminate in the garage. But ever after that, she insisted on sniffing suspiciously whenever I brought anything electronic into the house. That was the first summer I considered running away and joining the circus.

The Unpleasant Surprise

Every surplus buyer has at least one of these in his or her career. The Unpleasant Surprise may take on many forms, such as discovering that those surplus filter capacitors which you carefully installed in your painstakingly constructed power supply mysteriously short-circuited ten minutes after power-up.

About all that's left is to stare glumly at the smoking ruin and comment at length on the morals, personal habits and ancestry of the capacitors and perhaps the surplus dealer.

Another variation on the Unpleasant Surprise is the Submerged Surprise. Of course, by the time you buy the equipment, most of the water has evaporated. Things look fine, you think, and you plug the receiver (or whatever) into the power socket. Everything works fine . . . for a year, a month, a day or an hour, depending upon how far the moisture-induced corrosion has to go to eat its way through one of the many fine wires in an i-f or power transformer.

Especially insidious is the Salt Water Submerged Surprise. All those dissolved salts in the sea water really up the ante in those games of chemical strip-poker going on in the dunked equipment. Even a prolonged fresh water rinse seldom helps. To avoid those rare cases where an unscrupulous dealer attempts to combine a Submerged Surprise with a Deliberate Burn, look for dried deposits on hard-to-reach surfaces between components. Corrosion on solder joints is another tell-tale sign.

The Pleasant Surprise

The penultimate goal of the surplus buyer. Everyone is pleased when things go his or her way. It's a natural part of the human emotional makeup. But there's a special kind of excitement known only on rare occasions which transcends everyday excitement.

Generally, it's associated with a "first"; for a beginning hunter, it's called buck fever. For a ham, it's that first QSO as a Novice. For a dyed-in-the-wool surplus buyer, it's called the Pleasant Surprise.

Last summer, my wife and I visited one of southern New Hampshire's famous flea markets. We arrived around three o'clock, which is rather late in the day to visit a flea market. Successful dealers have already sold everything, and unsuccessful dealers have begun to pack the chipped china, outgrown clothes, wooden coathangers and various forms of hideous bric-a-brac for the trip home.

As we browsed past the half-empty dealers' stalls, my wife called my attention to a wooden box perched precariously at an angle on the ground next to a still-occupied stall. "That box is full of electronic parts – maybe it's something you'd find useful."

"Thanks," I said and edged over toward the stall for a closer look. It was occupied by a man in his early twenties and an assortment of random junk which I estimated could easily load the battered '65 Chevy parked behind the stall clear to the scuppers.

I ignored the mismatched crockery and soiled paperbacks and concentrated on the contents of the box. About all that was visible consisted of some precision resistors packed in plastic bags, some manila envelopes and a double handful of mixed capacitors and garden-variety stuff. A hand-drawn paper sign read: $10.00 (which was crossed out); $5.00 (which was also crossed out); and finally, Make Me An Offer.

"Can I help you?" inquired the stall's attendant.

"Hi. Yes, I was interested in this box of parts. Would you consider an offer of two bucks?" I inquired.

The man hesitated. "Yeah . . . okay. I'm getting out of electronics and I don't want to cart the stuff home. But I do want the wooden box." With that, he produced a cardboard box and began transferring the parts.

After he finished, I thanked him, handed him the money and picked up the box. I carried the box to the car, locked it in the trunk and hurried back to rejoin my wife. We toured the rest of the flea market and found nothing else of interest.

When we returned home, I carried the box downstairs and spread the contents on the workbench. Surprise! One little brown envelope contained a dozen brand-new Hewlett-Packard hot-carrier diodes. Surprise! A slightly larger brown envelope was stuffed with expensive-looking CK-05 ceramic capacitors. Surprise! A grapefruit-sized bag yielded hundreds of 1N914 diodes; none had leads longer than an inch, but that's enough for printed-circuit work. Surprise! Another brown envelope held an assortment of tubular glass trimmer capacitors, all unsullied by solder or screwdriver.

It went on like that for about an hour. New and used parts of every description fell out of the envelopes. My $2.00 investment had turned into a king's ransom, a home brewer's delight.

Those are but a few of the things that can happen to you when you buy surplus stuff. The list could go on forever, especially when you consider the combinations. And remember, one man's White Elephant is another man's Pleasant Surprise, so keep your eyes open for trading possibilities. In these economically troubled times, a junk box well stuffed with surplus goodies can make the difference between a home brewed project and nothing at all, especially if you're out of work. Remember the motto of the Yankee Packrat: Don't Throw *Anything* Away! ■

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802B		1W	80W	C	229.00
1202B		1W	120W *	C	269.00
502	2M FM	10W	45W *	A	$119.00
802		10W	80W	C	199.00
1202		10W	120W *	C	239.00
1202C		25W	180W	C	299.00
2002		10W	200W	D	375.00
401	220 MHz FM	10W	40W	A	$133.00
801		10W	80W	C	249.00
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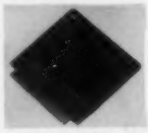

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by
David Brown W9CGI
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Space Age Junque

The guy that re-named junk, junque, must have either been trying to be funny, or realized early that one man's old is another man's gold! With thirteen plus years in electronics for fun (hobby-amateur radio) and profit (job-consumer electronics), I am just realizing "junk box" in ham magazines has long been misspelled. It takes most hams the first ten years to accumulate a good "junque box." The "junque box" route to better equipment can mean a complete item of surplus as easily as the bits and pieces. I purchased my first BC-348 for use as a tunable i-f for a tube type converter on 6 meters. I liked it so well (even though I have a TR-6 on 6 meters now), that I guess you could say I got hooked on them. The station and "junque box" now consists of five of them in various configurations.

I give you all this background because over these past twelve years I have collected every article on the breed I could lay my hands on. The BC series 224, 312, 342 and 348 are all close relatives, so this article will apply to them as well. It is the intent of this article to show how to put together the beginnings of a top quality VHF station an item at a time, by spending the dollars you have in the best places. While this article falls under the construction type, it is really more of a job of simple reconstruction.

We (Echo Amateur Radio Group) started our EME facility by compiling a list of already published articles, as covered by my article on EME, *73 Magazine*, Nov. 72, p 271. This article covers one of many modifications made to a BC-348 to adapt it for use as the primary receiver in our EME installation. If you can save money on the receiver, transmitter, or both, without sacrificing anything in quality, it will allow you to put it where it will do much more good. We, for instance, will be running 16 eleven element CushCraft antennas. Do you realize how little transmitter power is then required for use with Oscar? Not to mention what the huge capture area does for receiving gain at a point where tube or transistor noise doesn't kill you.

First things first, so for your "stew" first you must catch your "rabbit!" If you don't already own one, you can purchase fairly inexpensively a BC-348 in unmodified and running form from many surplus dealers. Many don't list them, since the demand is low. The whole modification can, and *should* be built, starting with the basic BC-348, and adding to it, checking out each phase as you go.

Basic Changes

Due to its airborne service, as part of the AN/ARC-8 Liaison Radio Group, the filaments are wired for 28 V dc and the B+ was derived inside the unit from a dynamotor. The dynamotor (ugh!) must go, and it is the second thing you will accomplish. The first? Get a schematic and get very familiar with the unit. Follow the signal, B+, and filament path, etc., through in your mind and locate components on your chassis. This saves many headaches later. Now carefully remove the dynamotor and tag or identify where all the leads attached into the chassis. From this point, most modifications start you rewiring the filaments for use with 6.3 V ac. Remember what a small amount of ac does to mask a very small signal? Better you spend your time building a 20 to 28 V dc regulated supply on the board shown with this article and leave the filaments on dc! Besides, there are many wires down in the i-f region of the chassis, and some if moved change alignment, BFO injection, etc. With this same

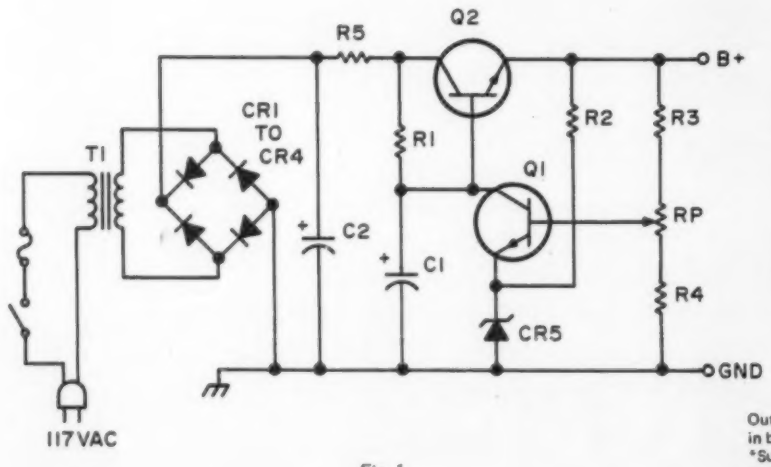

Fig. 1.

POWER SUPPLY VALUES

	28 V dc Version	160 V dc Version
T1	24 V ac 1.5 A	135 V ac 100 mA
CR1 to CR4	75 V 1.5 A	300 V 150 mA
C2	4000 to 8000 uF/50 V	500 uF 250 V
C1	100 uF/50 V	100 uF 250 V
R5	6 to 10 Ohms/7 W	56 Ohms/3 to 4 W
R3	22 Ohms/½ W	2700 Ohms/½ W
R4	"	"
Rp	220 Ohms/3 W	27k/1 W
R1	560 Ohms/1 W	8200 Ohms/½ W
R2	330 Ohms/½ W	6800 Ohms/½ W
CR5	20 V/400 mW	100 V/1 W
Q2	*Motorola MJ series (MJ1001) 50 V/2 A	Motorola MJ series or MPS U10 250 V/200 mA
Q1	Motorola MJ series (or 2N3053) 50 V/250 mA	Motorola MJ series or MM 3009 250 V/50 mA

Output voltage dependent solely on components loaded in board.
*Suggest use with moderate heat sink (i.e., power supply aluminum chassis).

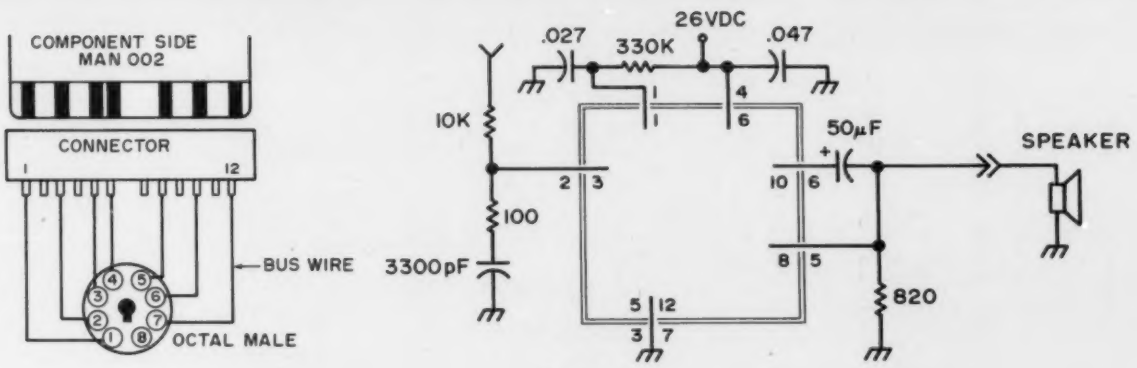

Fig. 2.

board and the second set of components listed, build the 160 V dc regulated supply. Follow the schematic and board loading diagram carefully, since this is the only "building" involved in this article. The lower than usual B+ is no accident. Two reasons most conversions ran the 210 to 255 V dc for B+ was they saw it on the original schematic, and to some degree it was required by the audio output tube. To eliminate the latter need, I have included what I feel to be the best way out of the "headphone audio" found in many surplus sets. In fact it actually eliminates the biggest heat producer in the chassis and ups the audio to speaker level in one blow.

Audio Changes

Fig. 2 describes a solid state audio system that drives a 35 Ohm speaker to as much audio as you could ever need. The speaker and the module to be described can be purchased from radio-TV service stores as an RCA replacement item. It fits into the same octal socket (with an adaptor you make), and gives off considerably less heat. This audio system runs reliably from 28 V dc, so now you know two reasons for leaving the filaments on 28 V dc. It can be purchased for less than you could build it, and definitely cheaper than replacing the output tube when it burns itself alive! The module is known as MAN 002, Sound Output, Part # 133455, and its socket used in making the adaptor is a 13 pin PC board inline, Part # 133634. Buswire is used to connect the inline to a male octal per Figs. 2 and 3. The module only draws 10 to 60 mA idle to wide open. You must rewire the audio output octal socket in the BC-348, but this is much easier than trying to pull it out and notch out the aluminum chassis (HA!). Do it in the following order and it goes quickly.

Removal

Remove the B+ leads from plate and screens, pins 3 and 4. Remove the audio output transformer. Remove the filament leads from pins 2 and 7 and note which is ground. Leave the ground connected at the ground end. Trace hot side to previous tube, and replace with same type of wire (same I capability) only long enough to reach to the area where the audio transformer was. Mount a terminal board having one insulated terminal and a ground in that area and mount on it a 15 Ohm/4W resistor, connecting one end to the extended lead and the other end to ground. This keeps the 28 V dc filament string series correct. Remove the lead to pin 1 to ground. Leave ground end connected. Remove lead from pin 5 (audio in) and don't lose the point the other end of this lead goes to. Remove lead to pin 8, both ends. Pin 6 is already unused and should be blank.

Rewiring

Install a 100 Ohm ½W resistor in series with a 3300 pF disc ceramic capacitor between pin 2 and a ground lug. Replace the lead that went to pin 5 (audio in) with a 10k ½W resistor with spaghetti over the full length leads and run to pin 2 same as the above connection which was a high frequency roll off filter. Use the wires left grounded in the removal process to ground pins 3 and 7, using the closest one to each pin. Wire a 330k ½W from pin 1 to 4. Wire a .027 uF paper or mylar 100 V capacitor from pin 3 (gnd) to pin 1. Wire a .047 uF (same type) from pin 7 (gnd) to pin 4. Run a lead (orange-for second highest B+) from pin 4 to a new power connector. I suggest a Cinch Jones 12 pin type P-312-CCT. This is a hooded plug so the cable can leave the chassis through a grommet hole and plug in at the power supply. The power supply chassis mount mate is a CJ type S-312-AB. Wire a 50 uF 25 V dc electrolytic capacitor with plus to pin 6 and minus to pin 5. Spaghetti may be needed on the leads. Wire an 820 Ohm ½W resistor from pin 6 to ground lug. This is a fixed load on the audio output. Speaker leads should be attached to pin 6 and ground and led to the new plug. Do not allow the lead from pin 6 to touch ground while receiver is on as this is a transistor output stage. That completes the change except for plugging in the adaptor and module.

Since SSB is around to stay, there is one modification that *must* be made to a BC-348 to use it effectively. Obtain a 350k audio taper pot and place it in the hole where the dial light dimmer pot is located. Remove and discard the dimmer and wire the bulbs direct (bypassing the pot). Extend the audio leads up through the hole used for rf section to i-f section leads (under the BFO switch). Mark this pot as volume or audio and remark the original dual pot rf gain. This way full or high audio can be used with the rf gain used to control i-f-BFO mixing levels.

That completes the BC-348 T M-1 and M-2 modifications. Ours is up to M-12, although several of the other 10 are somewhat specialized for Oscar and EME, such as full AFC, auto scan, motor control remote tuning, added i-f for panadaptor and discriminator meter – AFC take off, recorder drive, multi-audio out for record, etc. Each of these were added at very little cost, yet we

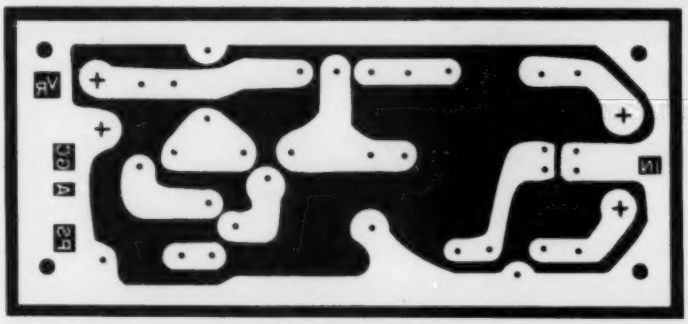

Fig. 3(a). PC board (full size).

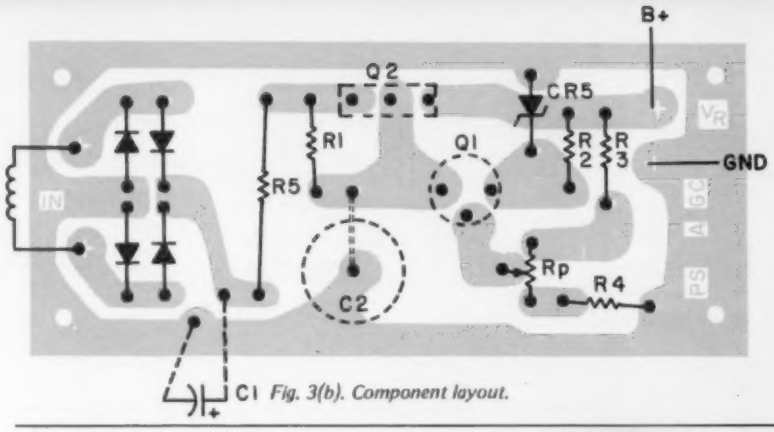

Fig. 3(b). Component layout.

now have a receiver comparable to that used at ground tracking military stations.

I hope to continue with follow up articles on the BC-348 T and other of our EME equipment to help generate interest in EME and the fascinating world of Oscar, and convince you that there are inexpensive ways of participating in these projects cheaply and without a huge antenna farm on your lot. I would be happy to help in any way I can on the BC-348 modifications in this article, but please make the questions as clear as possible and confine them just to these modifications and not the BC-348 as a whole. Don't forget an SASE.

Happy and "quiet" listening on your new breed "junque" receiver. ■

Oscar Orbits

Oscar 6 Orbital Information

Orbit	Date (Mar)	Time (GMT)	Longitude of Eq. Crossing °W	Mode
15432	1	0105:17	70.4	A
15444	2	0005:13	55.4	B
15457	3	0100:09	69.2	AX
15469	4	0000:05	54.2	B
15482	5	0055:01	67.9	A
15495	6	0149:56	81.7	B
15507	7	0049:52	66.7	A
15520	8	0144:48	80.4	B
15532	9	0044:44	65.4	A
15545	10	0139:40	79.2	BX
15557	11	0039:36	64.2	A
15570	12	0134:31	77.9	B
15582	13	0034:27	62.9	A
15595	14	0129:23	76.7	B
15607	15	0029:19	61.7	A
15620	16	0124:15	75.4	B
15632	17	0024:11	60.4	AX
15645	18	0119:06	74.1	B
15657	19	0019:02	59.1	A
15670	20	0113:58	72.9	B
15682	21	0013:54	57.9	A
15695	22	0108:50	71.6	B
15707	23	0008:46	56.6	A
15720	24	0103:42	70.4	BX
15732	25	0003:38	55.4	A
15745	26	0058:33	69.1	B
15758	27	0153:29	82.9	A
15770	28	0053:25	67.9	B
15783	29	0148:21	81.6	A
15795	30	0048:17	66.6	B
15808	31	0143:12	80.4	AX

Oscar 7 Orbital Information

Orbit	Date (Mar)	Time (GMT)	Longitude of Eq. Crossing °W
5905	1	0050:19	62.4
5918	2	0144:36	76.0
5930	3	0043:56	60.8
5943	4	0138:13	74.4
5955	5	0037:34	59.2
5968	6	0131:51	72.8
5980	7	0031:11	57.6
5993	8	0125:28	71.2
6005	9	0024:48	56.0
6018	10	0119:05	69.6
6030	11	0018:25	54.4
6043	12	0112:42	68.0
6055	13	0012:03	52.8
6068	14	0106:20	66.4
6080	15	0005:40	51.2
6093	16	0059:57	64.8
6106	17	0154:14	78.4
6118	18	0053:34	63.2
6131	19	0147:51	76.8
6143	20	0047:11	61.6
6156	21	0141:28	75.2
6168	22	0040:49	60.0
6181	23	0135:06	73.6
6193	24	0034:26	58.4
6206	25	0128:43	72.0
6218	26	0028:03	56.8
6231	27	0122:20	70.4
6243	28	0021:40	55.2
6256	29	0115:57	68.8
6268	30	0015:18	53.6
6281	31	0109:35	67.2

Cx

Because of the Canadian postal strike, last minute corrections to "RTTY Autocall – the Digital Way" (February, pp. 76-82) were not received in time for publication. The corrections are as follows:

- Page 76. The correct code for Calgary is T3A 3A9.
- Page 76, col. 1, line 20. Should read, "diodes, ICs and many resistors and."
- Page 76, col. 2, line 10. Should read, "units) such features as the NNNN shut."
- Page 77, col 1, line 4. Should read, "as keyboard-operated perforator turn on/off."
- Page 78, Fig. 2. "AA IN" and "CA IN" should be reversed. Also, "FORCE ON C" should have been inserted connecting to the top 7474, in a fashion the same as for the connections of "FORCE ON B" and "FORCE ON A."
- Page 79, col 1, line 30. This note should have been added at the end of the "Clock" paragraph: "If, when first powered up, the clock does not start, momentarily ground pin 15, V4. This will allow the clock to run through once. Operation after this will be normal."
- Page 81, col. 1, line 5. Should read, "printed circuit board that is stacked on top of."

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A PC Board Bonanza

The amateur experimenting with solid state projects certainly must have a well stocked junk box these days. Higher minimum order requirements, spiraling prices, failure of distributors to stock catalog items and slow delivery have left many of us with unstarted or unfinished projects. And it is getting worse!

The accumulation of tube vintage parts are of little, if any, use in solid state circuitry. On the other hand most of the mini discrete devices can be used to some advantage in even the latest IC lash ups.

The solution to the above, at this QTH anyway, is surplus PC boards. Let the buyer beware! There are circuit boards and then there are circuit boards. Keep away from the encapsulated board as well as the older and larger boards for obvious reasons.

As an example of the circuit board bonanza, I have acquired and stripped (with 85% recovery of parts) over sixty boards within the past six weeks. They were the small 2"x2½" computer boards, look new and were probably thrown out due to an imperfect test or were replaced by modern circuits. I kept a record of the most recent batch stripped. Here are the results. Out of 23 boards, costing $2.90, the following components were recovered:

126 transistors, mostly plastic, GP or switching types such as 2N3638, 2N3640 and 2N3646 or equal.

343 resistors. 290 were ¼ W 5%, others were ½ W 5% or ¼ W 1%. All good values.

61 capacitors. 45 were Mylar and 18 were SM midgets. 5 were Erie piston trimmers, each with a catalog price in excess of that paid for the whole batch of boards.

171 diodes, both silicon and germanium, equal to 1N914, 1N60 and 1N270, etc. Several were zeners in the 4 to 8 V range.

22 right angle, 15 pin connectors. These are perfect for joining a display board to a main board for counters and clocks.

As I mentioned earlier approximately 85-90% of the recovered components passed a preliminary test, were separated according to type or value and stored in partitioned plastic boxes for future use. Of the small percentage of rejects some were damaged in removal while some may have been defective when received. No component, new or used, is installed at this QTH without prior test. I learned that the hard way.

To accomplish the above high recovery rate takes patience, a good desoldering technique and the proper equipment. All equally important.

Let's start with the equipment. I will first list the minimum requirements then follow up with some very desirable additional items.

The basic tools are as follows: Needle nosed pliers, 4 or 6 inch. These should be of best quality with a sharp needle point, Klein 303-6 or equal; a solder aid/scriber equal to Moody MS-2; a small pocket type screwdriver, Xcelite R-3323 or equal; a small sharp pocket knife; a small vise; and a small soldering iron, such as an Ungar No. 776 with Nos. 1235 and 535 heating elements plus No. 331 and the No. 6940 Princess minitip. (More about this soldering iron combination later.)

The following items would make the work easier and would probably reduce the number of damaged components: A small multiposition vise such as Lafayette's 13P55916 would permit positioning the board at a more convenient angle; a combination bench light and 5" magnifier would help see those tiny leads and reduce eye strain; and a variac or equal would control the soldering iron temperature to just enough for the job at hand.

Now a word about that all important technique: We start with the choice of boards. Look for unencapsulated, 1/16" thick, foil on one side boards containing the items you want. Some transistors are user coded and, until someone comes up with a conversion table, might complicate your selection and testing. The component leads usually are cut about 1/16 to 1/8" longer than the board thickness and crimped before soldering. This is what we want.

We start with the transistors since we have no way of heat sinking them. Set up the 1235 element with a 6950 tip at about 80 V, if a variac is used, so that you have an element full of heat, at a low value, transferring instantaneous heat thru the minitip when it touches the foil. Hold the board in your hand, in a vertical plane, about 6 or 8 inches from the vise, touch the CLEAN tip to one of the foil pads JUST long enough for the solder to become fluid then QUICKLY remove the iron and at the same time tap the edge of the board smartly on the vise. The molten solder will fly off leaving the lead clearly visible. Lift the lead, with the knife blade, clear of the pad to a perpen-

dicular position. This will free the lead. Repeat the operation with the remaining leads in sequence. Do not desolder more than one lead at a time. The time used in lifting the lead allows the transistor to cool off a bit between heats. After the third lead is freed turn the board over and, using the knife blade, pry the transistor from the board. Straighten the leads with the pliers and lay aside for later testing. Remember, too much heat or heat applied for too long a time will ZAP the component.

Next in order of fragility are the diodes. Fortunately we can heat sink them by sliding one jaw of the pliers under the lead, grasping the lead firmly, then as heat is applied to the foil side we lever the diode lead free much as a dentist pulls a tooth. The pulling action straightens out the crimp as the lead comes free.

The same approach may be used on the capacitors and resistors. In some cases the scriber point must be used to lift the lead enough for the pliers to be slipped under it. While removing diodes, capacitors and resistors no tapping is required. Just clamp the board in the vise and use the iron in one hand and the pliers in the other.

The angle connectors are salvaged by using a hotter soldering combination plus the tapping technique to remove the solder before prying them free with a screwdriver. Work from both ends as the connectors are easily broken.

After the stripping operation is completed, sort the components, test and store them for future use. The GO-NO GO testing is done here using the Heath IT-10 Transistor Tester and a Simpson Model 260 Multimeter. An adaptor for the small transistors was made by soldering spring wire contact and leads to the proper pads of one of the stripped boards to allow testing in the IT-10. While the transistor leads are short they will fit thru a 1/16" board perfectly and are of top quality.

Surplus boards are available from many sources and at prices ranging from give away to all the traffic will bear. Select your PC boards with care. If you can't use the parts it's no bargain at any price. ■

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by
Robert Villastrigo WN5NBE
309 Irvington Place
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Government Surplus: Is It All Gone?

The label on the crate said "Radio Transmitter," and gave the coded model number. I knew that this particular model cost the U.S. Government $1235, and considering the paltry few cents I had bought the crate for, I eagerly pried open the crate and dug through five pounds of packing material to get at my prize. But I found no new radio transmitter. I found instead a dusty, half-empty wine bottle – and a cheap brand at that.

I was understandably disappointed, but not exactly surprised; buying from the world's largest and cheapest department store, the Defense Property Disposal Service, has increasingly become a test of patience, a kind of Russian roulette filled more and more with pitfalls. Sad to relate, the DPDS is rapidly losing its rating due to an apparent shortage of materials. Worse, the quality of the material available is declining, as is the frequency of the sales themselves. Another barometer is the price of the lots; costs have doubled and even trebled within the past few years. To cite some examples: Electronic equipment and spare parts weighing ten thousand pounds went for four cents a pound a year ago; now you will have to pay as much as thirteen cents a pound for the same amount of stuff. Last year, you could buy instruments at sixty-five cents a pound; now the same instruments at surplus will run you well over a dollar a pound. I recently paid nearly twelve dollars a pound for some Hewlett-Packard test equipment – double the rate I paid eighteen months previously.

There are instances to make both the taxpayer and the surplus buyer blanch. A short time ago 345 individual lots of electrical and electronic equipment came on the market. The lots cost the U.S. Government – and hence the taxpayer – just under $8 million. The whole shipment was sold off for $127,000. Much of the equipment was brand new, and most of it was still packed in original containers. Electronic lab equipment, aircraft parts and instruments that the U.S. paid $6 million for was parceled out to surplus buyers for less than $75,000. A good deal for the buyers, a bad deal for the taxpayers.

As staggering as these figures are, they are a drop in the bucket compared with what went on following World War II and the Korean War when you could buy an aircraft carrier at the scrap price of two cents per pound. The catch, of course, is that you had to move the thing yourself; this could be a problem if you lived in Boise, Idaho.

The surplus buyer's problem today is finding lots that contain worthwhile electronic equipment at prices that make their resale really worthwhile. And it's getting tougher all the time. Government contracts for defense have been sharply reduced, and in some cases cut altogether. New contracts for design and manufacturing are practically non-existent. Foreign aid programs have felt the weight of the Congressional axe. The wake of the war in Vietnam left no bonanza for the American surplus buyer; most of the goods left over from that war are being funneled right back to Southeast Asia and, increasingly, to Israel. Only driblets seep back to the country of origin, i.e., here, for sale to the public that paid for them in the first place.

I talked to one of the nation's top dealers in surplus electronics, Ray Kilby, who has some advice for anybody who wants to get into the surplus game. Kilby is an executive with S.P. Airparts in North Hollywood, California, and is ranked among the most prolific buyers of surplus materials. Kilby's prime concern is stockpiling parts and units against the day when the surplus supply is truly exhausted. To beginners who are contemplating bidding on their first batch of surplus as an entry into the game, Kilby has this to say: "Don't! It takes more years to learn the *little* things about this business than it does for any other professional to learn the *big* things about his profession. You don't stand a chance – unless you happen to be wildly lucky. Competition is pretty fierce right now, and is not liable to lessen. The average man can't plot a money-making career by waiting around to get lucky, and luck is the name of the game for the amateur surplus buyer."

If you decide that your luck is running good and want to go against veteran Kilby's advice, bear in mind that Government stocks are not as large as they have been in years past, and that you will be bidding against the pros—guys like Kilby. It's better, and safer, to buy the odd piece from your local junkyard or surplus store. Begin your own stockpile of items that will grow in value. Those ten-for-a-dollar printed circuit boards won't be around much longer. The $20-$30 receivers and transmitters that, with a small conversion, were so popular with hams and SWLs,

have all but vanished from the shelves. The latest government receiver on the market has a digital readout and goes for anywhere from $500 to $1400, depending on the condition. And there are not a great deal of even these expensive items available.

The top-ranked test equipment is just not making it to the shelves; most is being gobbled up by companies who are in the business of reconditioning and resale for a staggering price that can be afforded by a corporation, but not by the hobbyist or small businessman. Another factor facing the small buyer is the sheer sophistication of the equipment that sometimes becomes available; some of it is so specialized that it is useless for any function other than the one it was designed for.

Okay, so the picture is a little dark for those who might like to break into the surplus field as a career. This doesn't mean that the hobbyist or the inveterate do-it-yourselfer has to forego the pleasure of the hunt or the personal rewards of scouting for bargains. They are good buys in some items that haven't made it to the commercial field of electronics and won't have any industrial use until the advances made in military electronics are made available to the consumer. What we are talking about is real war surplus: overruns, over-purchased and over-ordered electronic equipment designed for the military, usually developed far in advance of the consumer market. Some of this stuff is really a stripper's delight, containing as they do many of the newer solid state devices that have a healthy price tag when bought new. A few power supplies are surfacing among the unidentifiables, and most have low voltages and are near-perfect for transistor applications.

A recent report from the West Coast reveals that the U.S. Government is bulldozing tons of good electronic equipment and turning it into a mass of unusable junk. The electronic equipment, ground to bits, was worth millions, destroyed, the Government says, because it had not been "demilitarized." In government jargon, to demilitarize is to render equipment unusable in its original form. In the past, a technician demilitarized a piece of equipment by using a pair of side cutters to snip off a plug or remove a meter. The equipment was rendered inoperable – but it *was* repairable. Unfortunately, this method of demilitarization has been brought to an end; the equipment is simply destroyed beyond redemption. Sadly enough, there are instances where the identical equipment can be purchased across many electronic dealer counters in pristine form – but for outrageous prices. If the public could have access to the plowed-under electronics, purchasers could have a real break on a fair-bid basis. What to do? Write your Congressman. If the present policy continues, the shortages will become even greater, the prices higher. It could come to the point where the great middle ground will vanish, leaving the individual purchaser no choice but outright junk or goods priced above his head.

Until that day comes, here are a few basic guidelines to the surplus shopper. When examining items, pay close attention to the way the crates are tagged. The items are tagged with one of three colors on tags about 3 x 8 inches. *Yellow* means that the described item is new or in operating condition. *Green* indicates an item that doesn't work, but that is repairable. A *red* tag means disaster; even government technicians are unable to fix whatever is wrong. These tags are usually correct, and a quick glance can save you plenty of grief. But remember that the really good stuff is going out the back door as soon as your local surplus dealer unloads the truck. The big dealers are there, waiting and, as the shortages grow, so will the lines of those waiting for good deals. Your best bet is to cultivate the friendship of one dealer; most will save wanted items for faithful customers.

If the flow of surplus material continues to choke off, many dealers who have had second homes at redistribution centers will fade from sight. Buildings and property around these once-bustling centers will become vacant. The employees, once junkmen, will become junkmen again. Leaving the empty warehouses, they will take to the roads in flatbed trucks, looking for junk. They will be hoping that someday the good times will roll again.

If there's another war, that is. ■

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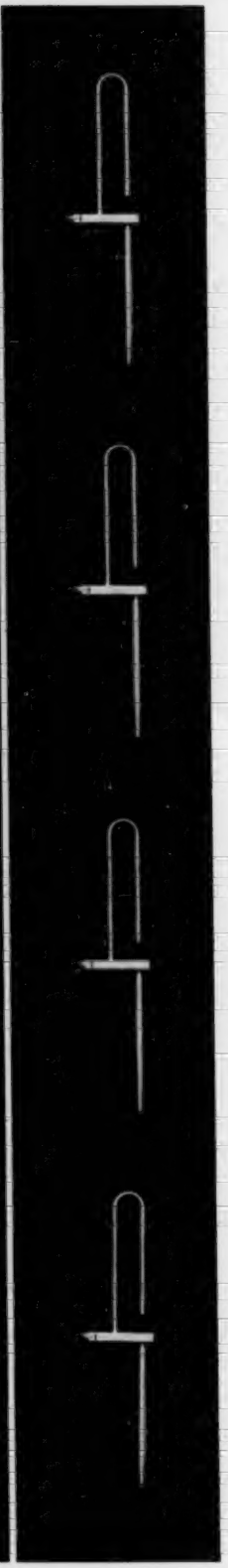

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by
Warren L. MacDowell W2AOO
11080 Transit Road
East Amherst NY 14051

An accurate wind speed indicator (anemometer) is especially difficult to design. The most significant problem becomes apparent when very low wind speeds are involved. The most common anemometer is the rotating "cup" device that in turn drives a small generator or electronic indicating device. The "cup" anemometer, at low wind speeds, must be very efficient (wind capture wise) and have little friction so as to detect low wind speeds.

The accepted reference for wind speed indication is a tube of a known diameter bent at a 90° angle which then directly feeds an air pressure meter. Of course, this tube must face the oncoming wind directly at all times and all tube dimensions must be taken into consideration. The air pressure meter readings are then converted to wind speed in

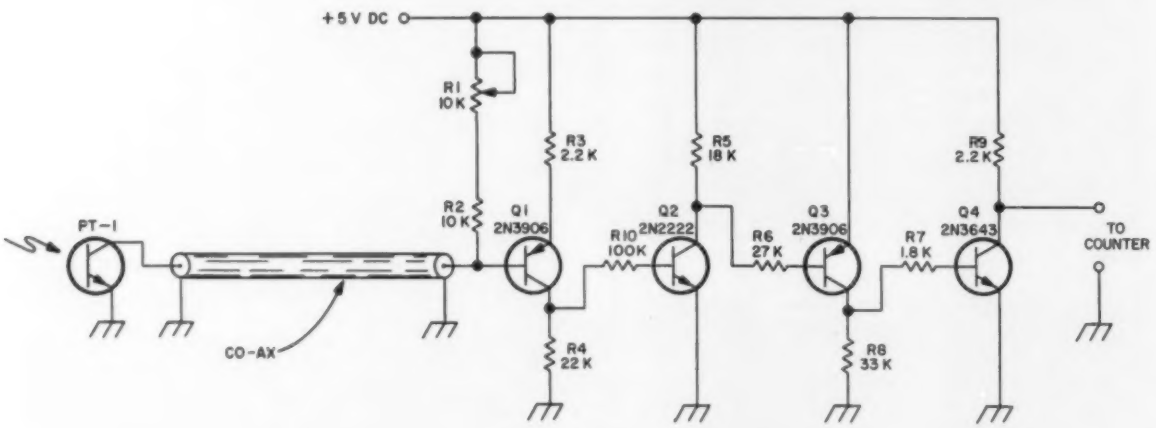


Fig. 1. Anemometer light activated trigger. PT-1 – Radio Shack FPT-100 phototransistor; Q1, Q3 – 2N3906 NPN silicon transistors; Q2 – 2N2222 NPN silicon transistor; Q4 – 2N3643 NPN silicon transistor, R1 – 10,000 Ohm trimpot; R2 – 10,000 Ohm, ¼ Watt carbon resistor; R3, R9 – 2200 Ohm, ¼ Watt carbon resistors; R4 – 22,000 Ohm, ¼ Watt carbon resistor; R5 – 18,000 Ohm, ¼ Watt carbon resistor; R6 – 27,000 Ohm, ¼ Watt carbon resistor, R7 – 1800 Ohm, ¼ Watt carbon resistor; R8 – 33,000 Ohm, ¼ Watt carbon resistor.

Wind

miles per hour, depending on air density, temperature and whether or not a bird is resting on the tube (coefficient of air friction depends on size of bird, number of feathers on body and how many seeds he has eaten the day before – owls excluded due to excessive mass).

Various other types of anemometers have been created. For example – those that expose an electrically heated wire to the wind and then measure the specific resistance of the wire. As the wire is cooled by moving air, the resistance would change accordingly.

The average ham shack in this day and age possesses a digital frequency counter with at least a one second input gate time. (If not, begin construction of one immediately.) Now, assuming that you have a frequency counter, you also need a device planted on your roof top that follows the wind speed and will produce one pulse every second when the wind speed is one mile per hour.

Creating a pulse that will trigger the counter is not much of a problem. Devising a way to generate this pulse at one time per second at one mile per hour is another story. We decided to generate the trigger pulse by using a rotating disc with a single hole drilled in its periphery to admit a light pulse. If a light emitting diode was placed above the rotating disc and a phototransistor below the disc, the hole would pass pulses of light as the disc was rotated. Phototransistors are very responsive and fast switching devices.

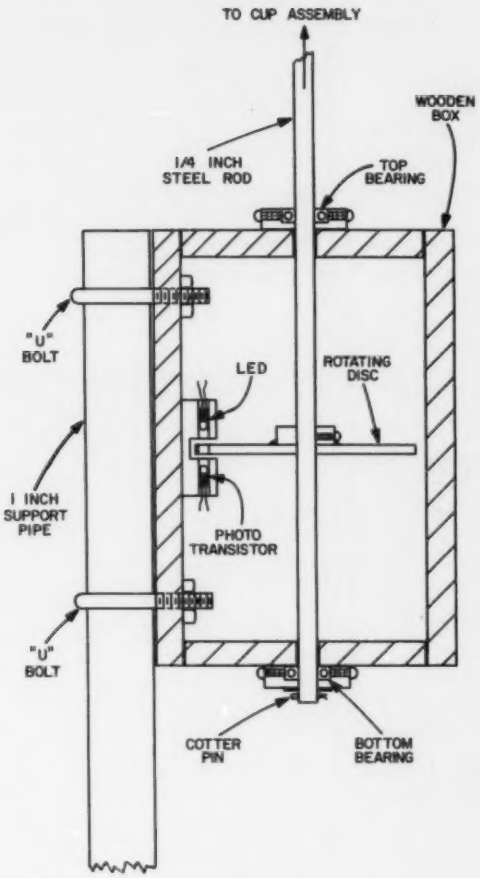


Fig. 2. Main indicator assembly.

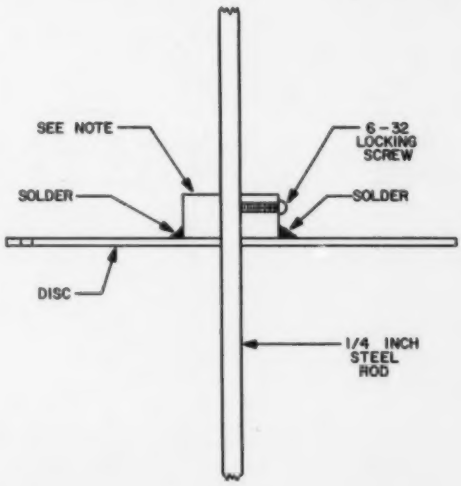


Fig. 3. Disc to shaft attachment.

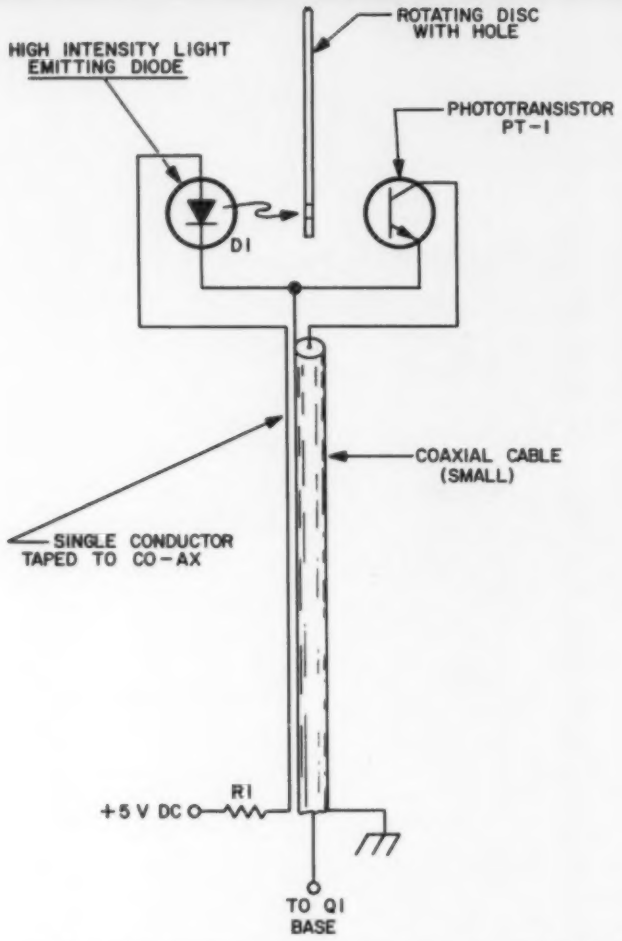


Fig. 4. LED – phototransistor cable. D1 – high intensity red light emitting diode (any bright clear red LED); PT1 – FPT-100 phototransistor (Radio Shack); R1 – 220 Ohms, ½ Watt carbon resistor; Coax – RG/59U or smaller. Miniature mike cable will also work.

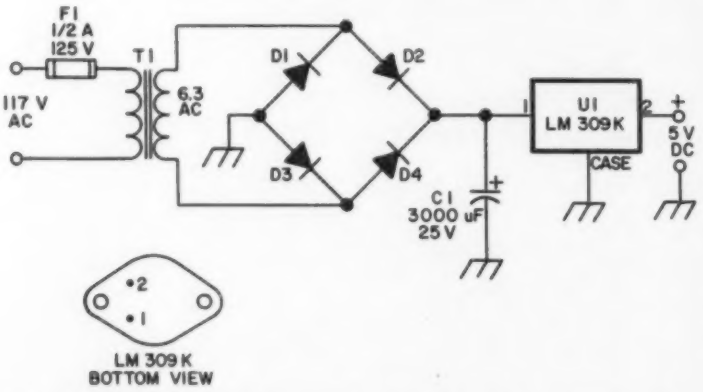


Fig. 5. Frequency counter anemometer power supply. C1 – electrolytic capacitor; D1-D4 – 1N4002 silicon rectifiers (50 V, 1 Amp or more); F1 – slow blow fuse; T1 – 117 V ac primary, 6.3 ac secondary 1 Ampere filament transformer; U1 – National LM309K 5 volt voltage regulator.

An LED as a light source should have a reasonably unlimited life span (the LED doesn't have a filament so theoretically never burns out).

The size of the rotating disc and position of the light passing aperture hole was determined as follows:

If the wind speed is one mile per hour, the air molecules must travel 5,280 feet or 63,360 inches in one hour (5,280 feet x 12 inches). Therefore if we have a small disc (friction free) driven by a cup type anemometer, it must have a circumference that would travel one mile in one hour when the wind speed is one mile per hour. If 63,360 inches = 1 mile and 3600 seconds (60)(60) = 1 hour then:

$$\frac{63{,}360}{3600}$$

would equal the distance in inches that must be traversed in one second to equal 1 mile per hour or 17.6". 17.6" would be the circumference of the disc with the light hole exactly at the edge. It is easier to construct a larger disc and drill the hole at the 17.6" circumference point. The diameter of a 17.6" circumference disc would be:

$$\frac{C}{\pi}$$

or 5.6". The radius therefore would be ½ of 5.6" or 2.8" from the exact center of the disc.

We happened to run across a "high intensity" red LED at a local hamfest and used this as the source of light for the phototransistor. Any common garden variety LED should work equally as well, as the dc amplifier following the phototransistor has plenty of gain. Of course the enclosure containing the LED/phototransistor combination must be reasonably "light tight" or extraneous sunlight will produce erratic readings.

The phototransistor used is a Radio Shack FPT-100. These sell in the neighborhood of 79¢. Of course there are many other types of phototransistors available and all are quite reasonable in price.

The FPT-100 phototransistor is capable of very fast response. It has a much faster response time than will ever be required by the anemometer trigger disc. If you want to make sure that the phototransistor is really functioning, attach a light emitting diode to an ac source such as a 6.3 ac filament transformer in series with a 1000 Ohm current limiting resistor. The 1000 Ohm resistor is a nominal value and may have to be decreased to obtain sufficient light intensity from the LED. Place the ac illuminated (modulated) LED directly in front of

the phototransistor and attach the output of the amplifier to your counter. The observed count should be 60 Hz. A more exotic method is to illuminate and modulate the LED with an audio generator. The counter should read the audio frequency directly as the phototransistor responds to the audio modulated LED. This virtually is the same as a photocell detecting audio from varying film density in a motion picture projector.

We have covered the construction of the rotating disc trigger and bearing support assembly. The next device is the rotating "cup" assembly. It is difficult to "peen" soft metal into a perfect cup shape to form the air scoops. We thought of using commercially manufactured soup ladles which are close to the desired shape. However, it seemed wasteful and expensive to hack up four perfectly good soup ladles. It finally occurred to us that L'eggs pantyhose containers are just about perfect for this application. These egg-shaped plastic containers split in half and provide two cups for the anemometer assembly. Therefore two L'eggs containers are required for the anemometer. If you haven't access to these containers, convince the XYL that these are definitely necessary to beautify her legs beyond belief and at least two pair are required should a "run" occur in one set.

The L'eggs halfshell is drilled so as to admit a coathanger wire toward the front half of the parabolic shape. Epoxy cement is used to secure the coathanger wire when inserted through the plastic halfshell. These plastic shells are weather resistant and normal corrosion will not take place. They are light and respond well to wind "excitation."

Fig. 1 is the fundamental C.C. amplifier that senses the variation in resistance of PT-1. This amplifier also provides the pulses of sufficient amplitude to drive a frequency counter. Parts placement is not critical so this amplifier may be constructed as a printed circuit or breadboard. As with any amplifier, the entire assembly should be shielded to prevent hum pickup or other extraneous outside noise.

Fig. 2 illustrates the mast attached box containing the LED-phototransistor sensor and rotating disc. The wooden box should be water and light tight.

The remaining illustrations are self-explanatory when constructing the anemometer.

What we have described is a device that will provide an interesting addition to your present frequency counter. At least it will remind you of when it is necessary to crank down your expensive 10 element 20 meter beam when the wind becomes beyond limits. ■

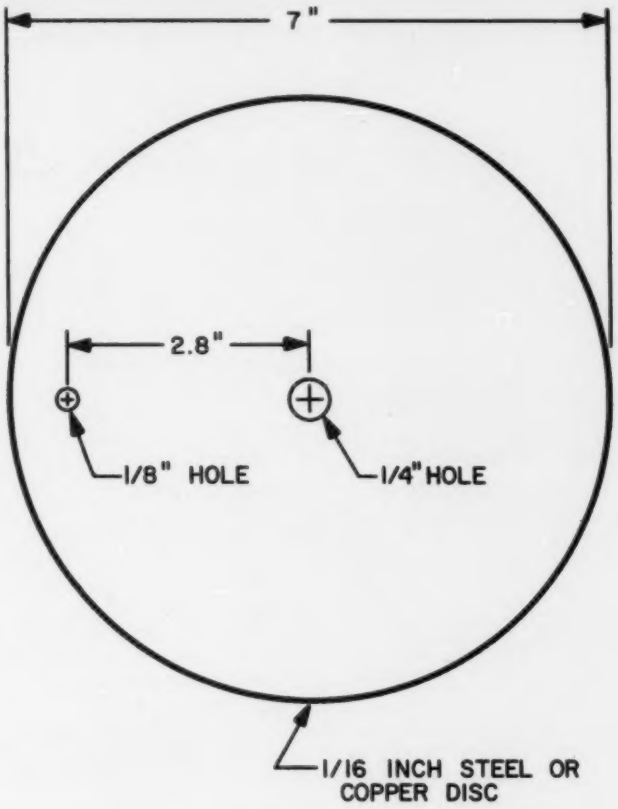


Fig. 6. Disc assembly.

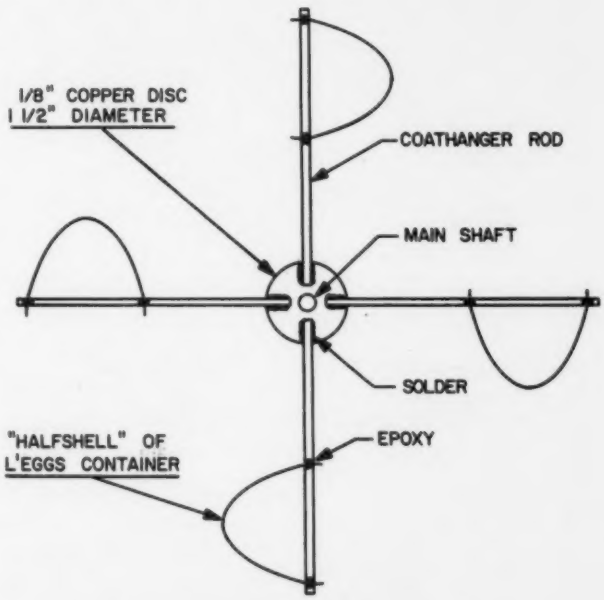


Fig. 7. Anemometer cup assembly, top view.

Stereo - A New Type of CW Filter

by
Robert L. Anderson W8KZM
391 Pleasant Ridge Ct.
Saline MI 48176

Does this sound like a familiar situation? You just installed a narrow band CW filter in your receiver and are now ready for that upcoming CW contest. Comes the weekend, and with it disappointment! Those rare multiplier contacts are still buried with strong QRM on each side. Your new filter is sharp, 400 Hz or so wide, with steep skirts on each side. However, somehow when you tune one QRMing station off on the low side of the filter, the station that was just off the high side is now S9, and the rare DX is still unreadable.

Having been in this situation myself during contests, or even in periods of heavy CW activity, I wondered if there was a way to further untangle the CW signals from each other. My particular receiver is the Heath SB-301 with the conventional 400 Hz CW filter. A still sharper filter might be an answer, but there are problems of dash-dot slurring due to the narrower bandwidth and filter ringing.

I then thought about using a pair of stereo headphones (or two speakers) together with a pair of high Q filters to channel each end of the 400 Hz CW filter passband into separate audio channels, thereby creating a "stereo" effect. It seemed to me that by doing this, it should be possible to use the ability of the brain to distinguish between the signal level arriving at each ear and to "compute" a location in space for the origin of the sound. With such a system, CW signal at 800 Hz would appear to come from the left and 1200 Hz signal from the right. Signals at frequencies between 800 and 1200 Hz would "appear" to come from various azimuth angles depending on the specific frequency as shown in Fig. 1. Tuning across the band, a signal will appear first to one side of the operator, then appear to drift across in front, and finally appear loudest in the other side before disappearing completely. By adding the feeling of spatial dimensionality to an incoming signal, it should make it far

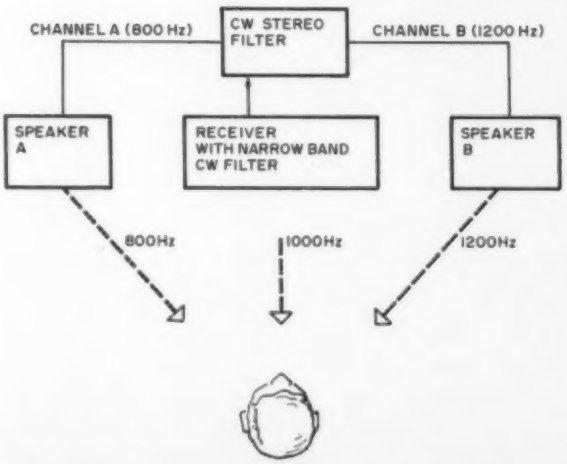
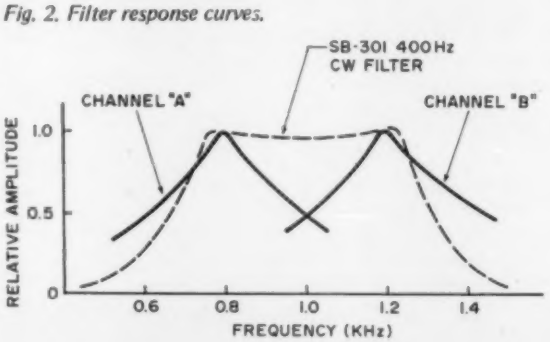


Fig. 1. CW stereo filter in operation. 800 Hz signals come from operator's left, and 1200 Hz signals from the right. Those signals in between (1000 Hz) will "appear" to come from directly in front of the operator.

Fig. 2. Filter response curves.



easier for an operator to concentrate on a single signal in the presence of several other QRMing signals on slightly different frequencies.

The Filter

The two separation filters were designed to have the characteristics shown in Fig. 2. One filter was designed to peak at 800 Hz, which is the low end of the passband for the CW filter in the SB-301. The other filter was designed to peak at the high end of the CW filter passband, or 1200 Hz. The Q of the filters was adjusted so that each channel will supply exactly 0.5 of its peak output signal at 1000 Hz.

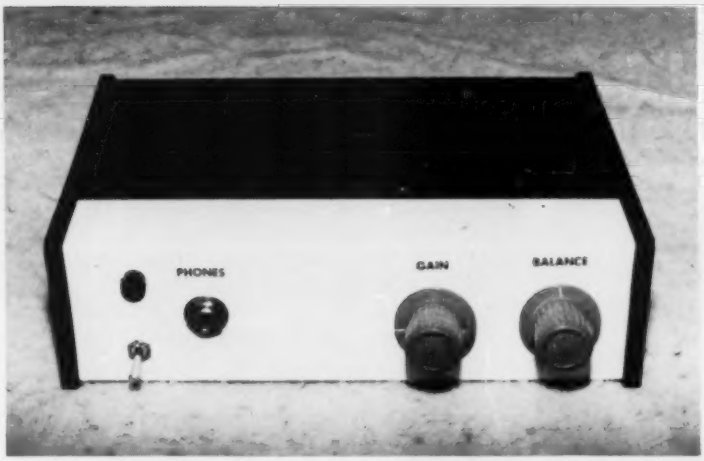
The Circuit

The circuit for accomplishing this is relatively straightforward, and uses 88 millihenry toroid filters to divide signals into the two separate frequency dependent channels. The entire circuit (see Fig. 3) consists of a single LM3900 quad operational amplifier and two power transistors for active components. The first amplifier section is simply a linear preamp to assure adequate voltage levels at the filter section. The two filters L_1, C_1 and L_2, C_2 are the 1200 Hz and 800 Hz filters respectively. Two more amplifiers buffer the outputs of the two filters and drive the bases of the output transistors Q_1 and Q_2.

Since stereo headphones are generally low impedance (4-16 Ohms), some extra current gain, provided by Q_1 and Q_2, is necessary. If, however, high impedance headphones (2,000 Ohms) are available, or fabricated by rewiring a pair of standard high impedance headphones, then Q_1 and Q_2 could be eliminated. Don't forget to keep the 35 uF blocking capacitors in the circuit, however!

The 3900 Quad Operational Amplifier

For those unfamiliar with the LM3900, a few words on its design are in order since it



is unconventional and understanding the principles of its use will be of help in troubleshooting the circuit. The LM3900 consists of four high-gain linear operational amplifiers in a single 14 pin DIP package. Each amplifier has a unique input circuit, called a "current mirror" rather than the conventional differential transistor pair. The LM3900 is designed to operate from a single supply. A schematic showing the connection of one LM3900 amplifier section as an ac coupled amplifier is shown in Fig. 4.

Correct dc biasing of the LM3900 is accomplished with R_1 and R_2. The amplifier output dc level is usually set to be equal to one-half of the supply voltage to give maximum ac signal swing. R_1 is selected to give approximately 10 uA of current into the positive input port, which acts essentially like the base of a NPN transistor:

$$I_2 = \frac{V_s - 0.6}{R_1}$$

With R_2 connected, the amplifier output will increase until $I_1 = I_2$, assuming amplifier saturation does not occur first. The LM3900

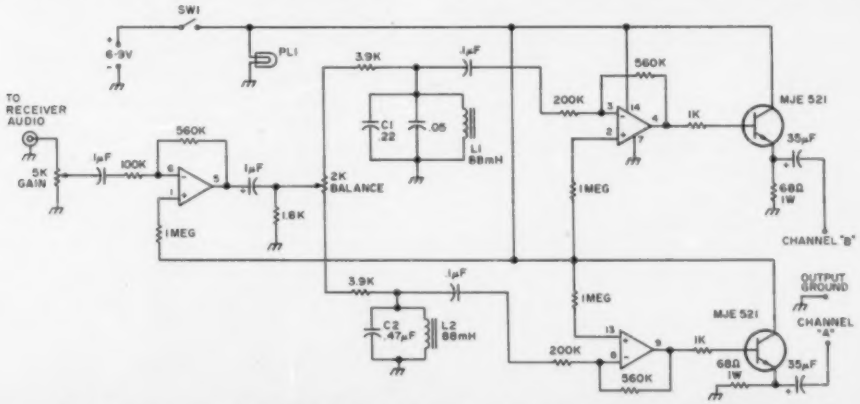


Fig. 3. Schematic of stereo CW filter. All resistors ¼ Watt, 5%, except where noted.

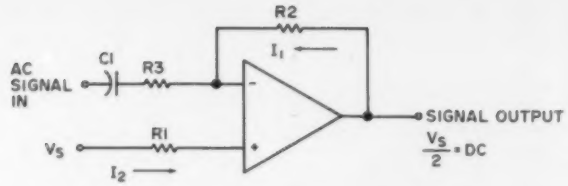


Fig. 4. The LM3900 as an ac coupled amplifier.

operational amplifiers operate on a current input balance and not a voltage input balance as do other amplifiers.

Since: $I_1 = I_2$ and $E_{out} = E_s/2$

then $R_2 \cong R_1/2$

The ac gain is set by: $G_{ac} = R_2/R_3$

And C_1 is selected such that for the lowest frequency of interest (f_{low}):

$$C_1 \geq \frac{1}{2\pi (f_{low})\ R_3} \quad X\ 10$$

The Hardware

The circuit was built on a PC board and then mounted on a Ten-Tec Model JW-8 (6" x 8" x 2½") cabinet. The gain and balance controls were mounted together on the right side of the front panel and the power switch, pilot lamp and three circuit phone jack on the left. See photo of the unit. The circuit can be powered by either a 6 or 9 volt battery or an internal 6-9 V dc, ac line power supply. The dc current requirement is approximately 200 mA.

The Results

The initial tests of the CW stereo filter were made using a pair of 16 Ohm Utah compact hi-fi speakers spaced about 4 feet apart and 2 feet above the operating position. The results were quite dramatic! The entire shack seemed to "fill" with the sound of the receiver background noise and CW signals, giving a feeling of listening depth never experienced before. Tuning across signals in the crowded portion of 40 meters, signals did indeed appear first on the left, seem to drift across the operating position and then dominate the right side. Tuning in two signals, less than 400 Hz apart, there was a definite dimensional quality to the signals. It seemed very much easier to concentrate, for example, on the W6 coming from the left and the CR6 calling CQ DX coming from the middle right hand side.

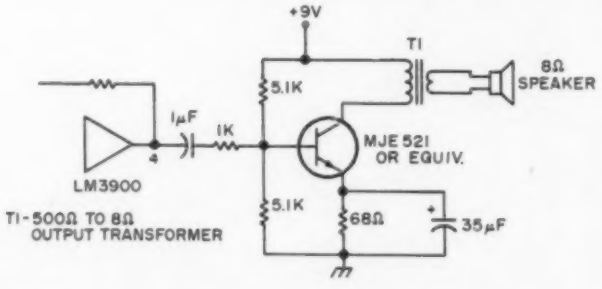


Fig. 5. Optional output stage (2 required). T1 – 500Ω to 8Ω output transformer.

Speaker phasing is quite important, and a noticeable change in the "signal-in-the-middle" effect was noted if the speakers are out of phase at 1000 Hz. When first setting up the system, experiment with the speaker phasing by reversing the leads to one of the speakers to see which configuration produces the best "signal-in-the-middle" effect at 1000 Hz. When the speakers are phased correctly, a 1000 Hz note should appear equidistant between the two speakers, and the signal should make a smooth transition between the two speakers when sweeping between 800 and 1200 Hz. There should also be a noticeable improvement in the "dimensional" effect when the speakers are phased properly.

If sufficient sound level cannot be obtained without distortion, then a higher output driver stage, such as the one shown in Fig. 5, is recommended.

The results using a pair of stereo headphones were not quite as dramatic as with loudspeakers, yet were still quite effective. Some of the "dimensionality" appears to be lost by using headphones, yet the separation of signals into the right and left hand channels is still quite apparent. Again, some experimenting with the headphone phasing is necessary to achieve the best effect. Since most stereo headsets employ a common ground, the connections may have to be reversed inside the plug or one headphone itself.

And Some Conclusions

This circuit is, I believe, a somewhat unique approach to the problem of separating QRMing in CW signals from each other. I would be interested in hearing from anyone else who decided to try this circuit to learn what their results and experiences were.

Further improvements can no doubt be made to this initial concept. One possibility is the addition of a third center speaker channel tuned to 1000 Hz to improve the dimensional effect. This would work, obviously, for the speaker method only, unless you have somehow been uniquely blessed with three ears! Also, I can supply PC boards for the circuit described in this article for $6.00 each. ■

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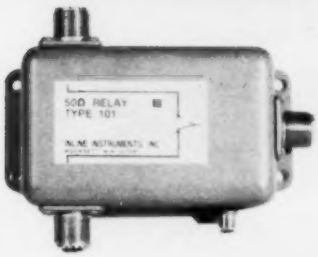

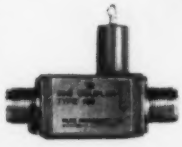

The coupler consists of a coaxial isolator and resonator which determines the bandpass of the device. When DC or AC power/voltage is connected across the coupler injection port and ground, the signal cable acts as a metalic link without disturbing signal characteristics originally present. RF signal path is not directional.

Two couplers can be used, one locally and one remotely, with the arrows pointing to each other. The coaxial cable between the couplers is thus multiplexed whereby the inner conductor and shield act as a simple wire pair while simultaneously carrying RF signals within the rated passband. Power/voltage may be injected or recovered at either coupler.

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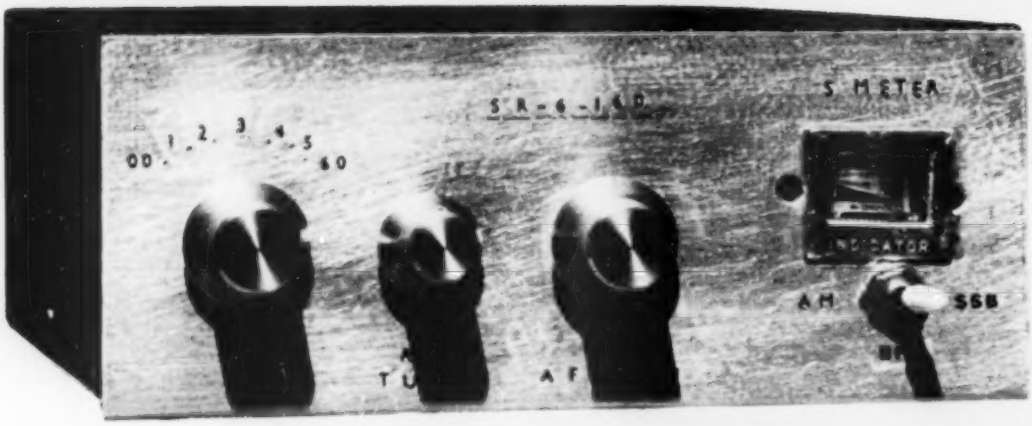


160m Solid State Receiver

by
Jim Wallich VK3ANY
154 Balwyn Road
Balwyn, 3103
Australia

Reprinted from *Amateur Radio*, The Wireless Institute of Australia, October, 1974.

It was decided to build a receiver rather than to convert a broadcast band "tranny" as it was considered that the normal cheap transistor portable would lack some essential refinements as well as sensitivity. What was aimed at was a set of such design that could be easily duplicated and therefore was not too complicated and did not require critical adjustment. Sensitivity was to be comparable to any good communication receiver and selectivity to be adequate for present activity in the VK3 area.

With these standards in mind a design which appeared some time ago in a British magazine was used as a basic format. By certain modifications and by leaving out what were regarded as superfluous refinements, an excellent "bird's nest" was produced on the bench and in due course this was drawn up and built on a printed circuit board. The final circuit is shown in Fig. 1. Tests carried out by VK3GK were so successful that the design is offered for the consideration of other amateurs.

Circuit Description

Firstly, it was decided to use germanium transistors as a number of these were available and had to be used up. Secondly, as an audio strip was also available this was incorporated into the unit although the enterprising builder can readily build his own.

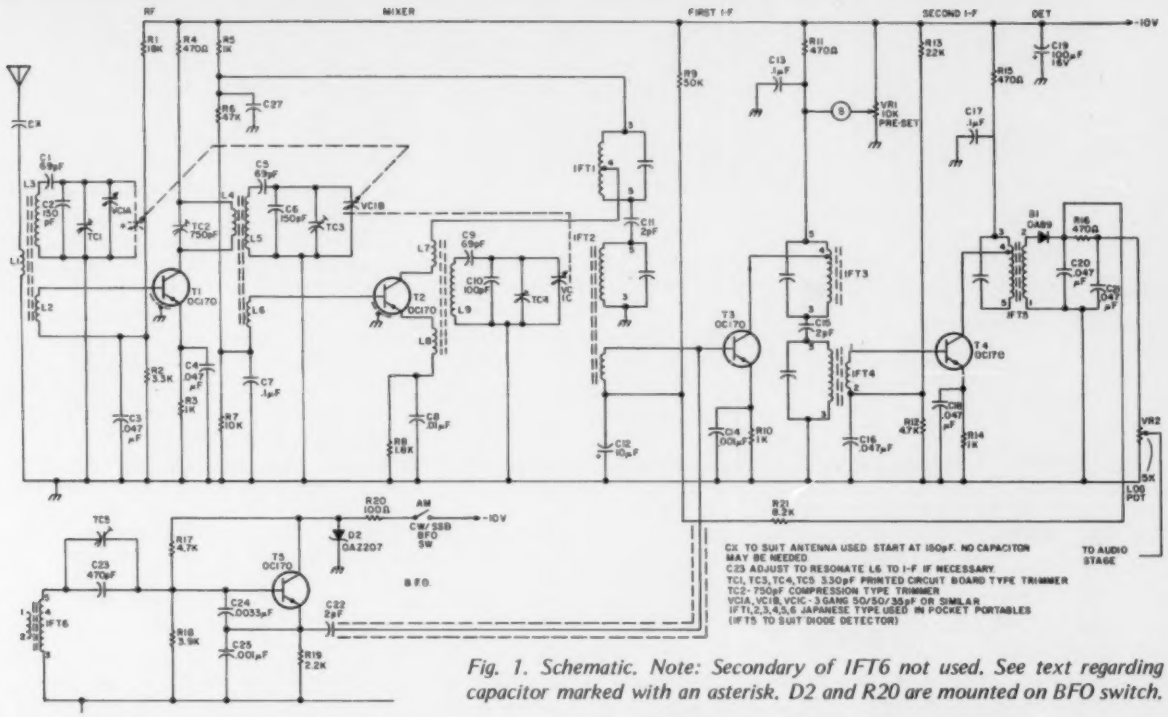

RF
MIXER
FIRST I-F
SECOND I-F
DET
-10V
TO AUDIO STAGE
BFO
CW/SSB BFO SW
AM
CX TO SUIT ANTENNA USED START AT 150pF. NO CAPACITOR MAY BE NEEDED
C23 ADJUST TO RESONATE L6 TO I-F IF NECESSARY
TC1, TC3, TC4, TC5 3.30pF PRINTED CIRCUIT BOARD TYPE TRIMMER
TC2 - 750pF COMPRESSION TYPE TRIMMER
VC1A, VC1B, VC1C - 3 GANG 50/50/35pF OR SIMILAR
IFT1,2,3,4,5,6 JAPANESE TYPE USED IN POCKET PORTABLES
(IFT5 TO SUIT DIODE DETECTOR)

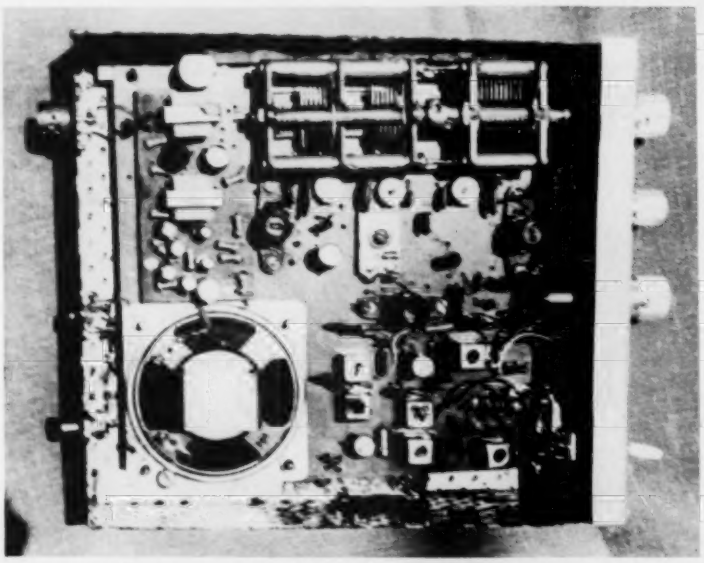
Fig. 1. Schematic. Note: Secondary of IFT6 not used. See text regarding capacitor marked with an asterisk. D2 and R20 are mounted on BFO switch.

The space on the board will easily accommodate one of the audio ICs now available. A little circuit designing is all that is required together with some modification of the PCB. A small (2½ inch) speaker could, it was discovered, be fitted to the board.

As will be seen the circuit follows conventional design. VC1A, VC1B and VC1C are ganged. Additionally, as shown, there is a small peaking capacitor across L3. This was found most useful as it compensates for any poor tracking that may occur when exact component values are not used. This capacitor may be 10 to 15 pF. It has been suggested that VC1A could be separate from the other two tuning capacitors in view of the difficulty and expense that may be encountered in obtaining a 3 gang unit. In practice such an arrangement does leave quite a lot to be desired as when it is off tune it really masks signals and consequently weaker signals may be missed. If a 3 gang cannot be obtained then one may be made up from a 2 gang and a single gang.

The IF transformers came from discarded broadcast receivers and are the small 5 pin type. It will be observed that in the case of IFT1, 3 and 5 the collectors are connected to the tap nearest to the cold end of the primaries. The resistance from the tap to coil is about 1 Ohm and the resistance from the tap to the other end is 2 to 3 Ohms. There are several different configurations for these transformers as shown in Fig. 3. IFT1 and 5 used in the receiver are type A whilst IFT3 is type B as illustrated. The constructor will have to check this point when selecting his IFTs.

At first sight the AVC circuit may appear very lightweight. However it is in fact very



Top view, showing placement of major components.

effective and no blocking occurs even on the strongest signals. The "S" meter uses a tuning indicator/battery level indicator from an old transistor set. Even when purchased new they are cheaper than ordinary meters; they are small and give a perfectly satisfactory indication of signal strength. The meter is adjusted to read half scale for an S9 signal and zero with no aerial connected. The BFO presented quite some difficulty as it was found that the fourth harmonic of the oscillator came out on 1820 kHz. Eventually a cure was found by tuning the IF transformers to the lowest possible frequency with the aid of a signal generator. This worked out to about 448 kHz. The fourth harmonic of the BFO thus moved to 1792 kHz – below the amateur band. Consequently no screening or special care is required and the BFO works very well. The BFO uses the same type of IFT as the IF except that the resonating capacitor is removed. (Gouged out is the only way I can think of describing the operation.)

The section reserved for the audio strip can be changed to suit the builder's own requirements particularly if he makes up his own audio stage. Remember that a screened lead must be taken from VC2 at the front panel to the PCB. The –10 V supply and earth wire must also be taken to the audio strip and wires run to the speaker from the audio output. The audio strip is fixed to the PCB with nuts and bolts together with spacers. The speaker is mounted on the component side of the board so that when the board is laid copper side down the cone faces downwards.

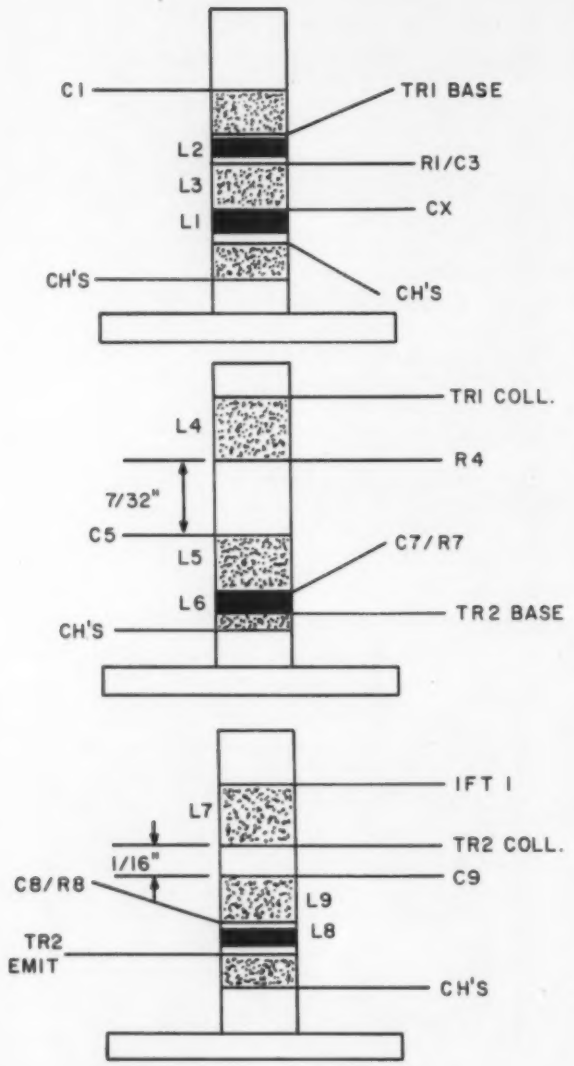


Fig. 2. Aladdin 804 formers. Coil wire #32 SWG enameled. L7 10 turns, L8 3 turns, L9 45 turns, L5 45 turns, L6 3 turns, L1 3 turns, L2 3 turns, L3 45 turns.

Construction, Adjustment and Tuning

Location of the main components on the PCB is the first step. Obviously a decision has by now been made on the ganged capacitor. Coil formers (Aladdin F804) are screwed to the board and the coil terminal pins either passed through holes in the board or soldered to pins as used on veroboard. The construction of the coils is not too critical; however, the dimensions should be followed as closely as possible. Above all ensure that the coils are connected properly. TC2 is soldered into circuit. A hole must be drilled through the board to allow the screw protruding from the underside to pass through.

Special care is necessary in drilling the holes for the IFTs. There are seven holes to each, which includes 2 for the solder tags on the can. Make all holes somewhat oversized as this simplifies the job. Do not overlook the fact that the can tags pass through holes in copper "lands" left to ensure an earthed soldering point. Wherever possible mount resistors (all ¼ Watt) in a vertical position to reduce space usage.

Once all components have been fixed in and a thorough check has been made, connect VR2 and switch on the supply voltage. DO NOT connect the BFO at this stage. Check that the current drain is not excessive and that the base, emitter and collector voltages are satisfactory. Obviously, if all is well, some kind of noise should emanate from the speaker, though this may be only a click when a screwdriver or probe is touched in a sensitive area.

If a VTVM is available confirm that T2 is oscillating. A lead brought from the antenna terminal of the station receiver to the

vicinity of L9 will give an indication if the receiver can tune around 2.3 MHz or a harmonic of this. The oscillator should cover 2240 to 2310 kHz.

Autodyne mixers can be tricky sometimes even when correctly wired. If difficulty is experienced and you are certain that the wiring has been correctly executed it will be necessary to fiddle around to get the stage to "fire." Once it does it will be a "goer" ever after and give no trouble.

Adjustment of the rest of the receiver follows standard practice, but remember what was said about the BFO earlier. Line up the IFTs using a signal generator on a frequency of 450 kHz or lower.

Injection of a signal from the signal generator in the area of L5 enables the mixer stage to be aligned. The same applies to the rf stage.

Alignment of L4, L5 and L6 together with TC2 requires some explanation. The positioning of L4 is arranged to give a limited degree of coupling. If the slug of L5 is unscrewed too much it increases the coupling to a point where oscillation occurs. Therefore once the basic alignment has been achieved, set TC3 to mid capacitance, screw in the slug of L5 practically all the way to the bottom of the coil, and adjust TC2 for maximum signal. Then unscrew the slug to peak the signal and again adjust TC2. This procedure should be followed until the stage oscillates. Screw in the slug to restore stability and readjust TC2. It should be possible to vary TC3 through maximum signal without oscillation occurring.

Initially C14 was 0.1 uF. It was found, however, that when IFT2 was peaked there was instability. By changing C14 to 0.001 uF the stage became docile.

It should now be possible to receive a signal though it may be necessary to wait for an amateur station to come on. Good results can be obtained even using a poor antenna such as a few feet of wire.

Incidentally no mention has been made of the coverage of this unit. This depends on the builder who can spread the band as much as he likes depending on (a) the capacity of VC1A, B, C, and (b) the values of C1, C5, and C9. The padding capacitor used in the prototype enabled the receiver to tune the band over about 60 degrees which is quite adequate.

The BFO may now be switched on. A VTVM rf probe at C22 will indicate whether the stage is oscillating. With the receiver tuned in to a signal generator at 1820 kHz, set TC5 to mid capacity and adjust L6 until a good beatnote is heard. Set it to zero beat. This beat should tune from high pitch through zero beat to high pitch. Check that removing the signal removes the beat as it is quite possible that the 4th harmonic of the BFO itself may be tuned if the IF frequency was not set below 450 kHz. The harmonic will still be heard below the amateur band with the correct IF frequency.

Unfortunately, there are so few SSB stations working on the band that it has not been possible to establish with certainty that the level of injection is optimum. With the coupling to T3 base there is plenty of injection available. More or less can be had by adjusting C22. If trouble does arise, C22 could be connected to T4 base or into its collector. These options are simple to experiment with but can only be tried with a regular and reliable SSB signal. This is left to the constructor.

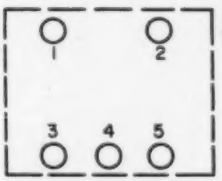
There is only a slight tendency for the BFO to drift in the first few moments. The constructor may prefer to mount TC5 on the front panel as a BFO tuning control. As such it should have a value of about 10 pF. For the CW enthusiasts who like to vary the tone this is certainly a must.

Performance

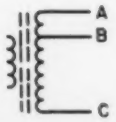
Originally the rf transistor was an OC170. This came to grief and was replaced with an OC44 without other changes. No instability was noted during tune up so, if available, the OC44 is recommended.

As for performance it compares favorably with an FRDX400 on sensitivity. The latter is better (and I should hope so as it costs a lot more), but not to the extent that I could not work anyone that anyone else was working. Selectivity is adequate for the present degree of activity on the band. For mobile working an external speaker is used as the small inbuilt speaker is a bit "hissy" and doesn't combat noise as well. Stability is very good; even dropping it a small height does not detune a signal.

To conclude, it has proved to be reliable, effective, simple to build, rugged and easy to get going. I couldn't see myself without one. ■



I.F.T. VIEWED FROM BELOW



PIN NUMBER					
1	2	3	4	5	
SEC	SEC	A	B	C	TYPE A
SEC	SEC	C	B	A	TYPE B
SEC	A	C	B	SEC	TYPE C

Fig. 3.

Tubes Are Not Dead!

by
Bill Pasternak WA6ITF
14725 Titus St. #4
Panorama City CA 91402

Not very long ago, there appeared in a *73* editorial a call for construction projects using tubes rather than transistors. The reason given was that many of our old time constructors don't really understand transistors that well and have thereby let the art of construction die. I personally find myself caught in the middle. My interest is basically VHF, but I am a child of the '60s transition era, the period of time in which the electron tube gave way to the semiconductor. I am also a professional TV service technician by profession, so I was forced to learn both art forms, tube and transistor, to survive in my industry. Therefore, while these days I tend to build using transistors, FETs, ICs, etc., I still do quite a bit of work with electron tubes, if only to eat!

When I entered amateur radio back in '59, I was just out of high school with little "bread" to spend on setting up an amateur radio station. I did have a good friend named Sol Rosenthal WA2MSX who was one of those "old school" radio technicians and was never too busy in his store to find the time to stimulate the ideas of this "youngster" – and answer the many questions that my mind would bring forth. "Jommie's" radio store was a veritable gold mine of old radios and TV sets, many of the former dating back to the '20s. So little "Billy," from about age 10 on, spent all his after school hours

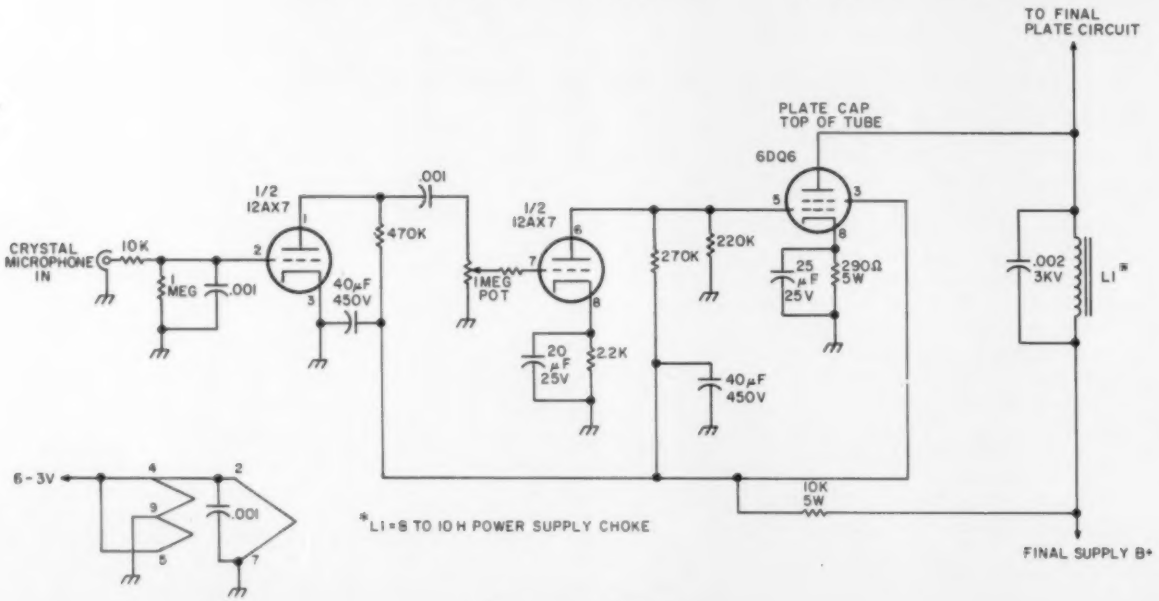


Fig. 1. AM modulator.

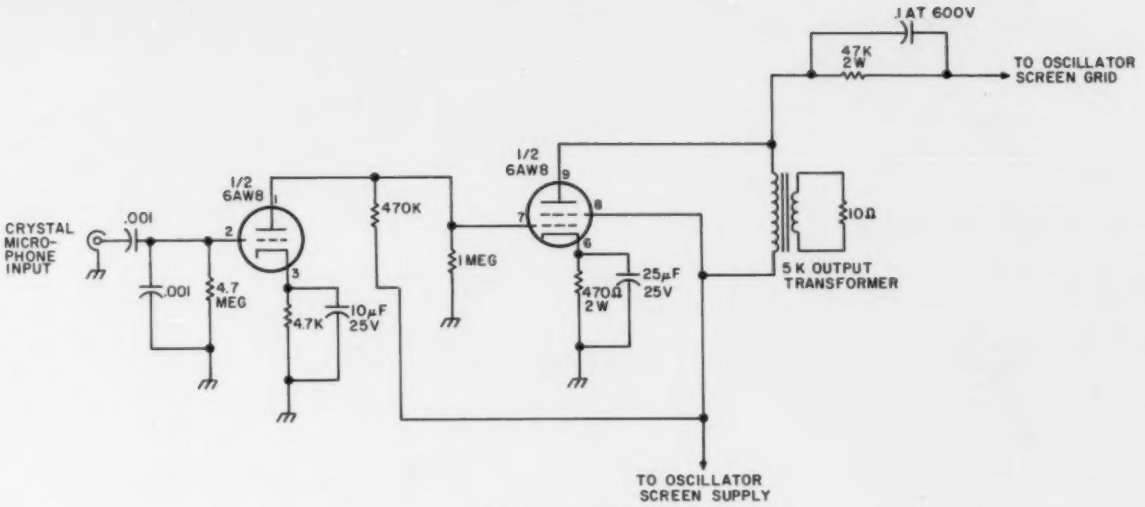


Fig. 2. FM modulator.

"hanging around" this fantastic learning spot, being educated in the true tradition of electronic repair. I was one of the lucky ones, for I received the kind of electronic education that no school can ever hope to offer. I was taught "little tricks of the trade" that have benefited me in later life – the type of education for which I will be eternally grateful.

I built my very first transmitter under Jommie's tutelage, on the side portion of his "L" shaped front counter. It was far from state of the art for the time. With salvaged parts from an old Dumint TV set, circa 1952, it consisted of a 6AB4 oscillator multiplier driving a 6BQ6 final doubler. Modulation was of the AM controlled carrier screen grid variety, using a 6SL7 speech amplifier and a 6SN7 control tube. A power transformer, 6AX5 rectifier, choke and a couple of filter caps made up the rest.

Oh, I forgot to mention, this was a VHF transmitter for six meters and amazingly enough it actually worked! Loading into a "V Beam" TV antenna through 150 feet of twinlead, it reached Orlando, Florida on its first contact – *my* very first contact!

Since that time, I have continued to build whenever the bug hits me. Of late it tends to be in the realm of solid state, but when the call went out for tube type projects, I dug back through my files to see what I could come up with that would not only fill the bill but perhaps be an incentive to help repopulate six meters, a band that is all but deserted these days. What you see here is a basic design that Larry Levy WA2INM and I came up with back around 1964 or 1965. It can be built with a number of different inexpensive tubes of the type commonly found in older tube-type TV sets, and in fact the entire transmitter less chassis can be salvaged from an old TV receiver. Just add your own enclosure, any fancy metering circuits you might desire, and package as you like. The only necessity is to follow good VHF construction technique, i.e., keep all leads as short as possible and bypass everything to ground with .001 disc ceramic capacitors. If you want to make a little larger investment, substituting a type 2E26 or 6146 for the TV sweep tube in the final will provide higher efficiency and greater power output for a given power input level. Depending upon supply voltage and final amplifier tube used, the transmitter can run up to 50 Watts power input AM or 65 Watts on FM or CW. AM modulation is accomplished by use of a beam power tetrode connected as a choke-coupled heising modulator, and FM by re-connecting this modulator to screen-grid modulate the 8 MHz oscillator tube (crude but effective; this is a low cost project) and keying the final amplifier cathode for CW. It's truly a "gut-level" transmitter with few frills.

A type 6BA6 tetrode functions as an electron coupled oscillator at 8 MHz, with the plate circuit left broadly tuned through use of a 2.5 MHz choke coil. A type 6AU6 will function equally well in this stage. The frequency multiplier is a type 6AQ5, though a 6CL6 will work better, and a 6BQ5 or 6CZ5 would also function quite admirably. The latter tube types necessitate a 9 pin tube socket and an RCA tube manual to determine pin connection. This stage is a x3 multiplier to the area around 25 MHz. In turn, the 25 MHz energy is coupled to the final amplifier tube of your choice, in this case a rather inexpensive type 6DQ6B hori-

Loading into a "V Beam" TV antenna through 150 feet of twinlead, it reached Orlando, Florida on its first contact – *my* very first contact!

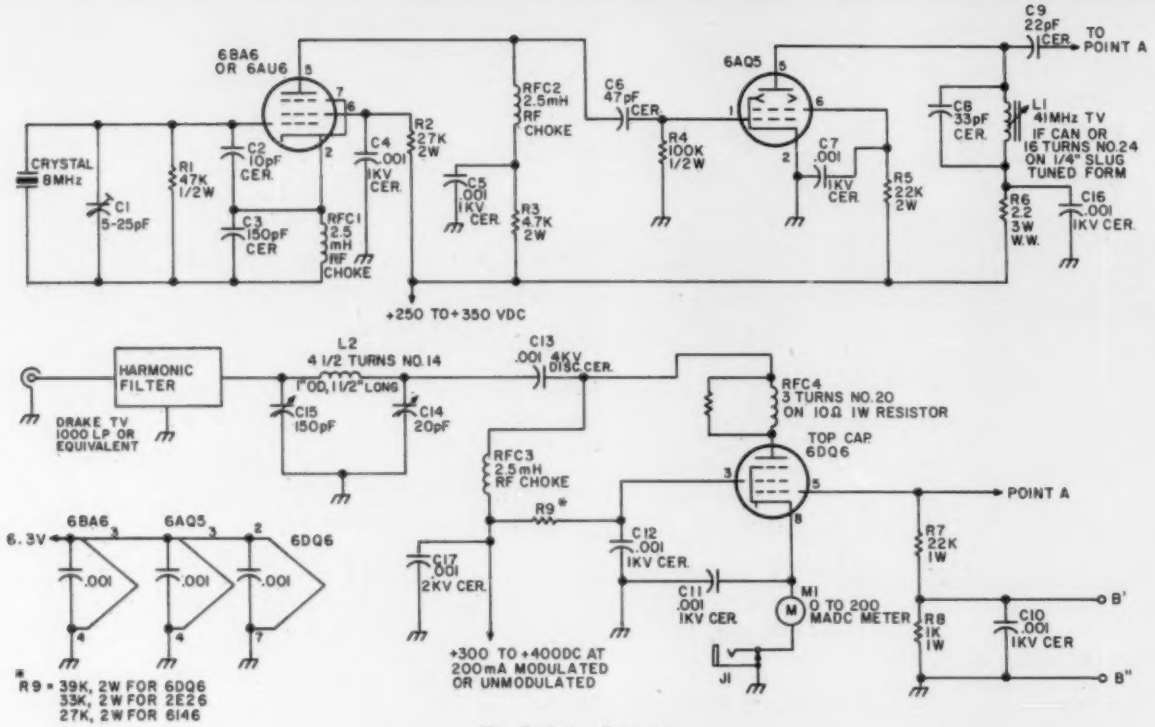


Fig. 3. Basic rf section.

zontal sweep tube. The plate circuit of the final is tuned to 50 MHz and pi-net coupled to the antenna terminals. Since the final amplifier acts as a frequency multiplier, it is quite rich in harmonic output and should not be connected directly to the antenna. A built-in Drake TV-200-LP filter works wonders here and makes it about as clean as a straight-through final running without the filter. The rf section is simple, neat and requires no neutralization. In fact, if you can get the final amplifier to self-oscillate, you had better tear the whole damn thing apart and start with a new layout. It's that stable. As to meter readings, with 275 volts applied to the driver and oscillator and about 400 volts to the final, you should run around 3 mA final grid current and 100 to 110 mA final plate current (when tuned into a 50 Ohm load). The easiest way to tune it up is peak the oscillator and multiplier for maximum grid current, then use an swr bridge in the antenna line and tune for maximum forward power. If it's working OK, maximum power output should appear at a minimum dip in plate current of the final.

For CW operation, just insert a key, flick the T-R switch to transmit and go CW to your heart's content. Since the oscillator and multiplier are running all the time, there is no chirp, and if your power supply is clean, the note will be clean and sharp.

For AM, just insert the modulator module in series with the plate supply voltage to the final, tune as noted (except keep plate current of the final below 100 mA), adjust the gain control on the modulator until the plate current needle starts to kick slightly on voice peaks, and *voila* good AM.

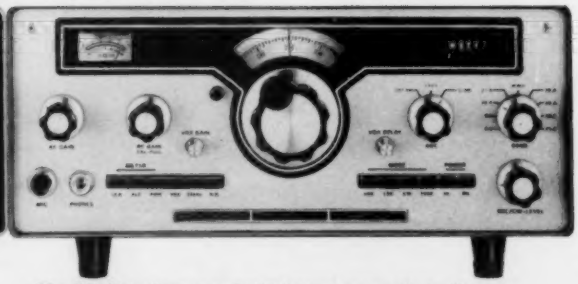
FM requires a bit more attention, but not too much more. The FM modulator takes the place of the screen grid resistor in the oscillator. Remove the screen resistor and insert the FM modulator module in its stead. There is no gain control on the FM modulator, but it does require close-talking the mike. Experience has proven that an extra preamp stage here leads to over-deviation. We found that 3" from the mike usually gives 5 to 6 kHz deviation, and quality is good. A frequency warping capacitor across the crystal sockets is used to zap yourself onto channel.

While many of you who are advanced in the art of design and construction may be cringing by the time you finish reading this, the others who are looking for a cheap, simple and utilitarian multi-mode transmitter for six meters may well find that what has been described here meets their needs. Best of all, if you can build at all, it will probably work well the first time you tune it up. Maybe tubes are dead, but they're far from buried. ■

State of the Art...

Heathkit SB-104

Heathkit HW-104



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Kit SB-614, Shpg. wt. 17 lbs. **139.95**

SB-634 Station Console: 24-hour clock, 10-minute ID timer, RF wattmeter, SWR bridge, phone patch.
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Kit SB-644, Shpg. wt. 10 lbs. **119.95**

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Reviews and articles in the major Amateur magazines have consistently praised the 104's because of their advanced circuitry, reliability and sheer operating pleasure! If you're serious about Amateur radio, you owe it to yourself to find out more about the 104's. For complete descriptions and specifications, order the new FREE Heathkit catalog. Send coupon today!

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Put a Pin Hole in Your Cadillac's Roof

73 Magazine Staff

Most amateurs who use 2 meters would prefer to have a ¼λ whip mounted directly in the center of the roof of their car for mobile use. Such an antenna is economical, provides a good omni-directional pattern, and usually is at least as efficient or more efficient than gain-type antennas mounted on lower positions of the car body. It also makes for a very neat looking installation. The big drawback of the mounting of such an antenna is the "hole in the car roof" problem. Commercial antennas require large holes or even multiple holes. Some methods have been described for the construction of home brew antennas requiring only a ¼" hole in the car roof. But WB2QVW has come up with an idea for mounting a whip on a car roof which literally requires only a "pin-hole" to be made in the car roof – a single hole of 1/8" diameter or even less. A mounting is used which allows the whip to be removed when the car goes through the car wash or for replacement purposes. A second alternative mounting is also described which does not allow the whip to be removed except from the inside of a vehicle. This type of mounting might be applicable to a vehicle which has a non-padded roof interior such as some recreational vehicles.

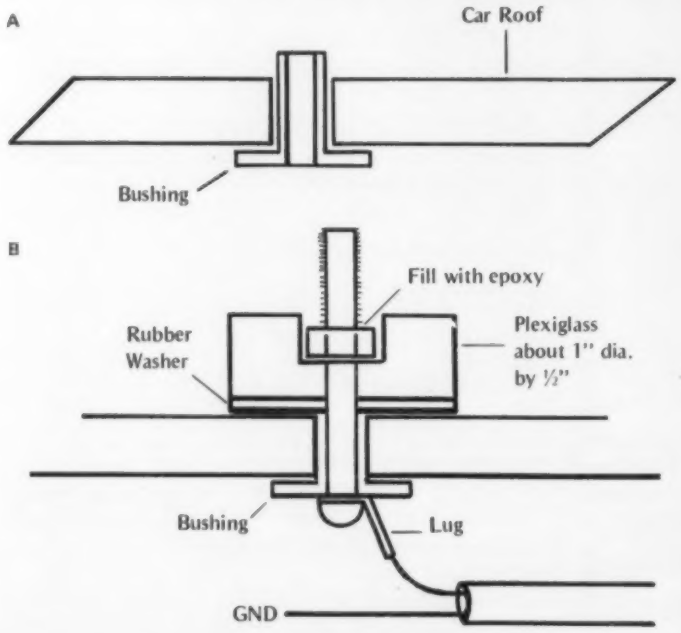

Fig. 1. The heart of the antenna mount is a fiber or nylon shoulder bushing (a). The complete assembly is shown in (b).

The electrical reason ¼λ whips can be mounted on a car roof with such small holes is that the base of the whip presents a low impedance, low voltage point so that elaborate insulation is not needed at the base of the antenna. Such mountings would probably not be suitable for ½λ antennas

which present a high impedance at their base. With a ¼λ whip and a 50 Watt output signal with a reasonable swr, the rf voltage at the base of the whip to ground should be no more than 5-75 volts. Mechanically, the simpler and smaller the antenna mount, generally the weaker it will be. Unless one lives in an area with extreme snow and ice conditions, however, the occasional replacement of the whip portion of an antenna may be a small price to pay versus putting up to a 7/8" hole in the roof of a car for a heavy duty commercial mount.

The first type of mounting is shown in Fig. 1. The heart of this mount is a thin, long plated steel bolt as shown in Fig. 1(a). A #4 (.115") bolt is probably the thinnest one would want to use although a still smaller #2 could also be tried. One may have difficulty obtaining such a bolt (1½" to 2" long) at the local hardware store; another alternative would be suitable size machine screw stock, which usually comes in one foot lengths, cut to any desired size. The bolt is inserted in a nylon spacing bushing which insulates it from the roof. An alternative is the use of a shoulder washer inside the car roof and a short fiber spacer for insulation as the bolt goes through the roof. Still another alternative is to "build" a nylon spacing bushing up from a fiber spacer and a flat fiber washer whose inside diameter matches the outside diameter of the fiber spacer. A look at the hardware assortment in a store should provide other possibilities also. Either fiber, nylon or teflon spacers/washers are suitable.

A solder terminal is used under the bolt head to provide a connection to the antenna. Another solder terminal may be used to pick up a ground point by inserting it next to the car body. Outside on the roof, a circular or cone-shaped block of plexiglass or similar material (even wood) is used to build up the antenna base. A nut in a recessed hole on top of the block secures the bolt and the recess is then filled in with epoxy. The antenna proper is secured to the stud which remains above the block. The antenna proper can consist of almost any light-weight rod material one has on hand, but a very suitable material is brazing rod. It comes in 19-20" lengths and about 1/16" diameter. It should be available at any welding supply store, or even any garage which does body repair work will have it. The rod can be soldered to a few nuts which have also been soldered together and screwed on the stud. If one has the facilities, one could machine a small part to mate the rod and stud. Still another possibility is to use a banana socket to fit over the stud and solder the rod to the socket. As a final touch, a small cone-shaped plastic insulator as found on an alligator clip should be slipped over the whip to cover the stud to provide a rain cover.

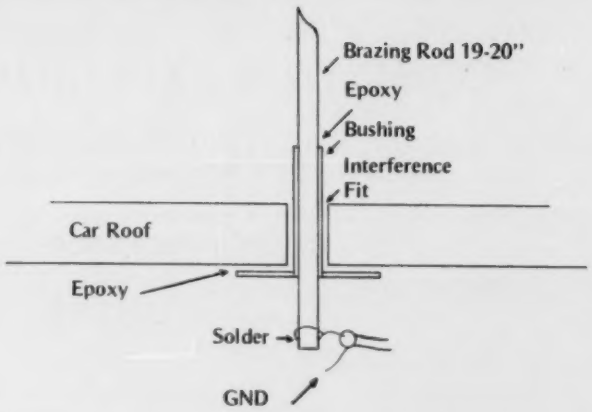

Fig. 2. The super simple mount. Total antenna cost is about 25 cents!

The whole assembly as described may sound a bit simple, but it will work very effectively and if constructed with care can look very professional. All this for a cost outlay of less than $1.00!

If one really wants to have a simple but equally effective 2 meter antenna at a total cost outlay of about 25 cents, take a look at Fig. 2. This simple antenna makes use of a brazing rod and a nylon or fiber spacer bushing (or any of the substitute assemblies previously mentioned). The hole made in the car roof need only be slightly larger than the brazing rod. As shown in the diagram, epoxy is used to secure the mounting to the car roof and the antenna rod to the bushing. This extremely simple mounting does not provide any means to remove the antenna. But for many recreational or sports vehicles which don't go through a car wash, this is not a problem. Such vehicles usually have unpadded interiors on the roof and if something should happen to the antenna, it is a simple manner to put in a new antenna at a replacement cost of 25 cents! It is assumed that one can pick up a ground connection near the antenna – by a bracing support or dome light – without having to make a hole that penetrates the car roof.

Trimming up of the antenna on a specific operating frequency consists simply of putting an swr meter in the transmission line and cutting down the full length whip in about 1/8" steps. A point will be found where the swr drops sharply to about 1.5 to 1 or less. Rather than cutting further one can make a final trim by forming a small U bend at the tip of the antenna. The value of further trimming once one gets the swr down to the 1.3 to 1.5 range is of moot value with the usual 5-10 foot transmission line. ■

The whole assembly as described may sound a bit simple, but it will work very effectively and if constructed with care can look very professional. All this for a cost outlay of less than $1.00!

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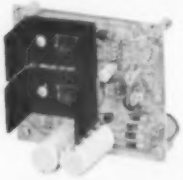

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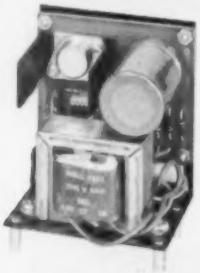

MD-5-3
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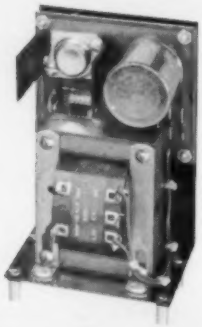

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– MICROPROCESSOR INSTRUCTION SET –

ABA	Add Accumulators
ADC	Add with Carry
ADD	Add
AND	Logical And
ASL	Arithmetic Shift Left
ASR	Arithmetic Shift Right
BCC	Branch if Carry Clear
BCS	Branch if Carry Set
BEQ	Branch if Equal to Zero
BGE	Branch if Greater or Equal Zero
BGT	Branch if Greater than Zero
BHI	Branch if Higher
BIT	Bit Test
BLE	Branch if Less or Equal
BLS	Branch if Lower or Same
BLT	Branch if Less than Zero
BMI	Branch if Minus
BNE	Branch if Not Equal to Zero
BPL	Branch if Plus
BRA	Branch Always
BSR	Branch to Subroutine
BVC	Branch if Overflow Clear
BVS	Branch if Overflow Set
CBA	Compare Accumulators
CLC	Clear Carry
CLI	Clear Interrupt Mask
CLR	Clear
CLV	Clear Overflow
CMP	Compare
COM	Complement
CPX	Compare Index Register
DAA	Decimal Adjust
DEC	Decrement
DES	Decrement Stack Pointer
DEX	Decrement Index Register
EOR	Exclusive OR
INC	Increment
INS	Increment Stack Pointer
INX	Increment Index Register
JMP	Jump
JSR	Jump to Subroutine
LDA	Load Accumulator
LDS	Load Stack Pointer
LDX	Load Index Register
LSR	Logical Shift Right
NEG	Negate
NOP	No Operation
ORA	Inclusive OR Accumulator
PSH	Push Data
PUL	Pull Data
ROL	Rotate Left
ROR	Rotate Right
RTI	Return from Interrupt
RTS	Return from Subroutine
SBA	Subtract Accumulators
SBC	Subtract with Carry
SEC	Set Carry
SEI	Set Interrupt Mask
SEV	Set Overflow
STA	Store Accumulator
STS	Store Stack Register
STX	Store Index Register
SUB	Subtract
SWI	Software Interrupt
TAB	Transfer Accumulators
TAP	Transfer Accumulators to Condition Code Reg.
TBA	Transfer Accumulators
TPA	Transfer Condition Code Reg. to Accumulator
TST	Test
TSX	Transfer Stack Pointer to Index Register
TXS	Transfer Index Register to Stack Pointer
WAI	Wait for Interrupt

MPU INSTRUCTION SET

The MC6800 has a set of 72 different instructions. Included are binary and decimal arithmetic, logical, shift, rotate, load, store, conditional or unconditional branch, interrupt and stack manipulation instructions.

MPU ADDRESSING MODES

The MC6800 eight-bit microprocessing unit has seven address modes that can be used by a programmer, with the addressing mode a function of both the type of instruction and the coding within the instruction.

Accumulator (ACCX) Addressing

Immediate Addressing

Direct Addressing

Extended Addressing

Indexed Addressing

Implied Addressing

Relative Addressing

A COMPREHENSIVE DESCRIPTION OF THE MICRO - SPHERE 200 SYSTEM

The Micro-Sphere 200 Series computer is the most ADVANCED, low-cost computer SYSTEM available today. Together with a TV and up to three cassette recorders you can have big computer performance at a rock bottom price.

The system features a 6800 type micro-computer with 4000 characters (4K Bytes) of internal Random Access Memory (RAM) Storage. The memory is easily expandable to 8000 total characters with the addition of an optional second 4K of RAM, with even more memory to be made available shortly. The 4K bytes of memory is equivalent to 6-8 pages of close typewritten material.

Access into the Micro-Sphere is achieved by the keyboard or from cassette recorders. The computer can display information on a standard TV screen (optionally supplied) or store information on a cassette recorder.

The keyboard uses highly reliable keyswitches to insure user satisfaction. It is full alpha-numeric including an integrated numeric key pad. The cassette interface uses the "Kansas City" standard which means that you can use even the least expensive cassette recorders with your system satisfactorily though we suggest that you do use high quality tapes with your system.

You may use your own TV without modification as the system display device, or you may purchase one from Sphere.

The power requirement is a single 110 volt AC outlet. The unit uses less power than an ordinary 100 watt light bulb. All fuses, jacks, switches, and interface signals are provided on an easy-access panel at the rear of the cabinet.

The Micro-Sphere is supplied with a built-in loading program from cassette, which is in one of the several standard or optional Read Only Memory (ROM) Integrated Circuits (IC). ROM IC's are pre-programmed with specific non-eraseable information. This feature greatly reduces program loading time and inconvenience, ROM's also save valuable RAM storage. RAM's lose all stored memory whenever the computer power is turned off, while ROMs retain all programs indefinitely.

The Micro-Sphere is unique in that 16,384 different dots on your TV screen can form any number of pictures or designs which you have instructed your computer to display. These images can be changed by the computer program at a rate that appears as real-life movement, such as aircraft flight simulation, "walk-through" inspection of architectual mock-ups, time-lapse stock market graphic analysis, or even computer generated art forms, or space flight simulation where you can guide your spacecraft to the moon, planets or the universe.

You can experience the thrill of rolls, dives, loops, near-collisions and other types of aerial maneuvers to out wit the Red Baron in your Sopwith Camel and then the excitement of a victorious landing as you crash at the end of the approaching runway.

This same 128 row by 128 column dot matrix can form an alpha-numeric display of up to 16 lines by 21 characters. An optional graphics input device (Mouse) digitizes hand movements when moved about on a flat surface. The "Mouse" has a window and crosshairs, so it may be used for the accurate entry of maps or other graphic data.

The mouse may also be used in the place of a joy stick for flight simulation or to enter hand movements for ping-pong or other games of skill.

The Sphere Cassette Operating System (SCOS) is supplied on tape and provides Assembler, Edit, and Debugging functions to the computer when read in to RAM from the Cassette. Sub-routines for floating point and trig functions are included in the SCOS cassette and may also be purchased as an option in ROM. Sub-routines are included in SCOS which provide all necessary alpha-numeric character generation for your TV using approximately 400 bytes of RAM. An optional character generator ROM can be purchased to reduce RAM usage to 50 bytes. SCOS also supports file handling.

If the second 4K of RAM is purchased the macro facility of the assembler is then available as an extended aid to help you in the development of your own programs. The second 4K of RAM will also allow you to read in extended Business Basic from cassette. This basic provides 16 digits of decimal accuracy and extensions for business use. This Business Basic can make use of the Floating Point and Trig Package in RAM or ROM to expand its capabilities into the engineering field. The Business Basic and Trig Packages are available in ROM, which leaves all of the RAM storage available for applications written in the Basic Language. This is a concept for which you may pay $9,000 to get from an IBM 5100 computer.

Sphere Corp. has included in the basic price of the Micro-Sphere 200 the Monte Carlo games package on cassette, which allows you to play blackjack, roulette, and other games just for fun.

One Cassette recorder is sufficient to do everything by simply changing tapes. Multiple file handling such as inventory control, pay roll, and general ledger processing etc. will be more convenient if two or even three cassette recorders are used. For example tape #1 may contain the last year-to-date accumulation file, tape #2 may contain the present pay period account, while tape #3 is used to combine tapes #1 and #2 into a new year-to-date accumulation master file. The second and third Cassette Interface options are available for those who require them.

In the near future, Sphere will release a Programmable Input/Output Controller for use with printers, disks, and other input/output devices.

The attractive two-tone case is made of mar-resistant high impact plastic designed to fit any modern decor. Additional strength and protection to components is provided by an internal metal chassis.

The unit is designed to operate in a normal home or office environment without any extra care. The Micro-Sphere is the product of many years of experience in the micro-computer field, providing a tremendous amount of power and capability in the smallest space-it requires only a small desk with space left over, and it comes fully assembled and tested--ready to use.

LIMITED WARRANTY — This unit is warranted to be in operating condition as described upon arrival.
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WHAT IS NOT COVERED — Power cord, fuses, damage incurred by shipping abuse, natural disaster, war or accident. Shipping, handling, postage and insurance are 2 percent in addition to purchase price.

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	Operators Manual		
	OPTIONS AVAILABLE THROUGH FACTORY INSTALLATION.		
	* To install options after purchase is $35.00 per shipment to our plant.		
"B" ITEMS	Second 4K of memory (RAM)	$180.00	$180.00
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	Second Cassette Interface	$50.00	$50.00
	Extended Business Basic (ROM)	$400.00	$400.00
"C" ITEMS	Includes Business Basic Manual		
	Floating point & Trig package (ROM)	$130.00	$130.00
	Third Cassette Interface	$50.00	$50.00
	OPTIONS FOR PURCHASE NOT NEEDING FACTORY INSTALLATION.		
	Extended Business Basic on Cassette (Requires 2nd 4K of RAM and Character Generator in ROM.) Includes Business Basic Manual Floating Point & Trig Package	$100.00	$100.00
	9" TV for use with Micro-Sphere 200	$150.00	$150.00
	"Mouse" Graphics Input Device (Available in May 1976) 2 ea.	$150.00	$150.00
	Operators Manual (SCOS)	$10.00	$10.00
	Business Basic Manual	$10.00	$10.00
	Maintenance Manual	$40.00	$40.00
	Empty Cassette Tapes 3 for	$10.00	$10.00
200A	INCLUDES MICRO-SPHERE 200 PLUS ALL OF "A" ITEMS ABOVE REGULAR $860.00	$860.00	$860.00
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			1765	2250*	**SPHERE 3:** Includes all the features of SPHERE 2, plus memory totaling 20K which is sufficient to run full extended BASIC Language.
522	622	**CPU BOARD:** Motorola 6800 microprocessor, 4K RAM, 1K EPROM (containing an EDITOR, ASSEMBLER, DEBUGGER, COMMAND LANGUAGE, CASSETTE LOADER, DUMPER, UTILITIES), and a REAL-TIME CLOCK.	6100	7995*	**SPHERE 4:** Includes all of the features of SPHERE 3, except the cassette has been replaced by an IBM-compatable Dual Floppy Disk System. This system includes a Disk-operating System and BASIC Language and a 65 LPM line printer.
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Wayne Green W2NSD/1

I/O EDITORIAL

uP

That's u as in micro, a P as in processor. The world of uP is changing too fast to keep in touch. Like the first really big uP chip was the Intel 8080, which came out at around $295, as I recall, and was a bargain at that price. Bill Godbout called the other day to lay our ears back with his latest deal . . . an 8080 (prime chips, he says, not seconds or rejects . . . prime), eight of the 2102 RAM memories for 1K bytes of RAM, plus a 5204 5K byte PROM . . . the works for $65. Lordy!

That should get the rest of the experimenters off their duffs and busy putting uPs together. What can you do with 4K PROM and 1K RAM plus a uP chip? Well, you sure can run a repeater to a fare-thee-well, have an extremely sophisticated keyer with all sorts of memory, and even play a lot of the simpler computer games. The fact is you have a simple computer which can be expanded with more RAM memory and some interfaces to work with slow scan, with teletype, cassette recorders, paper tape gear, etc. The only fly in the ointment is that you will have to accept that you are an experimenter and you won't for the time being find much in the way of assistance from friends or magazine articles.

One other thing . . . you are going to have to start boning up on how to program uP systems. With any luck we'll start running some articles in *73* on this. You might even be the one to write 'em.

THE GREAT COMPUTER PERIL

All is not skittles and scones (whatever those things are) when you put a computer kit together. Sure, you end up with a gadget that is more fun than a barrel of monkeys (to coin a phrase . . . say, have you ever tried out a barrel of monkeys? . . . or even one monkey? My folks had a monkey when I was younger and monkey-owning has its joys and sorrows).

Once you actually get your computer working and doing things (Herculean task, some say), it is all too easy to forget some of the goals you maybe had in mind for mating it with ham gear and succumb to the fun of putting in some game programs. The next step is all but inevitable . . . bragging to your family about it. Once you've opened your mouth you've essentially lost your computer, for you will have one heck of a job getting them to allot you some time with it . . . particularly if you have any kids between seven and forty-seven hanging around.

Look at the bright side as you are putting together your second computer. You have to admit that this is the first time you've built anything which was of interest to the family . . . and that your image has subtly altered from being just a weirdo who spends a lot of time soldering useless ham gear together and then presents his back to his family while he uses it. You may even begin to detect some slight signs of respect, however camouflaged. If you hang around behind corners you may hear your kids bragging to their friends about your wizardry. Oh, they'll still put you down at every opportunity if they think you can hear, but you watch and see.

Well, the prices on computer kits are coming down, so maybe it's a good idea to shop around and get a second one. Unless you have the good fortune to work in a chip factory, you'll probably do much better to go the kit route. The kit people are buying chips in large lots and the prices are enough lower so you'll have a tough time matching them.

YES, BUT WHICH KIT?

Hopefully we will begin to get some articles discussing the pros and cons of the various computer kits available. For many applications, there is less than a significant difference between systems based on the different microprocessor chips.

MITS got in there first and this has a lot of advantages for the home builder. A great deal of competition has built up aimed at supplying boards and peripherals for the Altair system. Thus the bus structure of the Altair has become an accepted bus standard. MITS further locked much of the microprocessor industry into their bus by bringing out their new 6800 based board using the same bus and plug compatible with the Altair 8800 system.

What's a bus? It's the wiring between all of the components of the computer. Rather than having each printed circuit board of the system plugged into the other boards as we do with most electronic systems, all of the boards plug into a common set of wires and the switching of signals is done with programming rather than real switches. It's a lot easier that way and saves on hardware as well as cabling.

Many firms are now providing kits of parts for boards which will work with the Altair system . . . memories, interfaces, clocks, etc. If you want to use a teletype machine with your computer you have to have a circuit to take the information from the bus and send it to the teletype. It has to ignore bus data intended for going in or out of memory, in or out of tape recorders, television typewriters, etc. Your interface boards only pass that information along addressed to a specific destination . . . such as a teletype . . . and they convert the information into the form needed for the unit being served. In the case of a teletype it would convert the bus info into a 20 mA series of pulses (or 60 mA if you are using a slower and older machine). For a cassette recorder it would convert the info to a series of frequency shift tones. Okay?

In selecting the kit of your choice you have a lot of factors to consider. Since all of them are pretty good, you won't really lose by throwing a dart . . . but it is possible to get a good enough grasp on what is happening to make an educated selection.

The older kits have the advantage of being much better supported with info on problems and programs. As you get more involved with computers you will begin to understand the overwhelming importance of programming. This is a new concept to most of us and we are inclined to give it short shrift. Don't. There is an awful lot to be said for a lot of software support for a system.

On the other side of the coin, newer kits are generally able to work a lot faster and have more sophisticated abilities. Progress has been extremely rapid in the microprocessor chip design field and there are substantial differences between older chips and the new ones. A dilemma. The newer chips are better, but we are going to have to wait a while before we can get much in programming for them.

One comforting aspect to this is that the above dilemma is not really of significant importance to stop you. Practically speaking, most of the expense of a computer system is in the interfaces, memories and peripherals . . . and there is no sign that we are going to have any breakthroughs in these which will obsolete your systems. You can start out with an 8008 based system and add memory, teletype, TVT, and use the wealth of data available for this older system . . . plus all the programs . . . and then change the CPU to a 6800 system and keep everything but the microprocessor itself.

One fact you are going to have to face . . . hard fact . . . programming is not going to be very meaningful to you until you have some hardware to get your hands on and learn by doing. Oh, we can explain the fundamentals of programming in articles, and then give you lots of clever ideas for improving your programming skills, but like Morse Code, you are on your own when it comes to really learning how to program.

Once you start to get the hang of programming you'll have a ball with it. With some of the systems, you can program in just about anything that you would normally expect would require switches to accomplish . . . converting from ASCII to Morse Code . . . at whatever speed you want . . . or from Morse to ASCII . . . or to Baudot. You can route the output to your rig, a repeater, lights, a teletype, a cassette recorder, door chimes . . . anything you want. You can program music generation . . . a whole bunch of people are getting off on computer music these days. You can generate

Continued on page 70

by
George R. Allen W1HCI
80 Farmstead Lane
Windsor CT 06095

What's a Computer?

Many experimenters are reticent to purchase and build a microcomputer system, even though complete systems can now be purchased for less than $100. This hesitancy on the part of interested experimenters can in most cases be attributed to several factors:

1. Temporary depletion of pocket cash.
2. Lack of knowledge of computer fundamentals.
3. Lack of personal confidence in being able to handle the technology required.

I have prepared a series of articles addressing problem areas 2 and 3 (problem 1 is only temporary!) by giving the experimenter a fundamental overview of computer principles. The various components of fundamental computer systems will be discussed, computer terminology will be explained, and fundamental, inexpensive breadboard circuits and experiments will be given in order to teach the rudiments of computer technology. The simple circuits and related experiments will give the experimenter the experience and confidence needed to build and debug computer circuitry.

The average experimenter with a basic knowledge of electronics who studies these articles and performs the experiments given should be capable of building and using his own microcomputer system.

What Is a Computer?

A computer is a device which accepts information, applies some prescribed process to that information, and supplies the results.[1] This definition can be applied to large classes of devices. For example:

1. A series of gears, shafts, axles, cables, etc., such as a speedometer, takes rotation of axle (accepts information), converts the information to usable form (applies prescribed process), gives reading of speed on dial (supplies results).

2. A frequency counter takes input pulses (accepts information), counts them (applies prescribed process-counting), displays frequency on an indicator (supplies results).

3. An amplifier takes a small voltage (accepts information), amplifies it (applies prescribed process-amplification), gives larger voltage as output (supplies results).

These three devices are all examples of "common" computers.

A "computer" is not always recognized as a "computer," and a "computer" is not always called a "computer." The term "computer" is a broad term and may be applied to common everyday devices. Computers need not be electronic, but may be mechanical, hydraulic, pneumatic, or perhaps biological.

What is a Digital Computer?

Computers are divided into two common classes: analog computers and digital computers. Both classes of computers are the same in that they accept information, apply a process to that information, and deliver results; however, they differ in the types of information which they can handle.

An analog computer processes information within a continuous range or within continuous ranges. Using the amplifier as an example, consider a simple device which will deliver a gain of precisely 100 to voltages in the range of .03 V to .08 V. In this amplifier an input of .03 V will give 3 volts out. An input of .039927 V will give 3.9927 volts out. This simple analog computer will operate with *any* voltage within its specified range. Furthermore, *all* values of voltage within the range of the device will be processed. The range of the information that the analog computer will handle is continuous – there are no gaps within the range.

A digital computer can process only discrete values (for example, in the range 1-5,

Fig. 1. Fundamental computer.

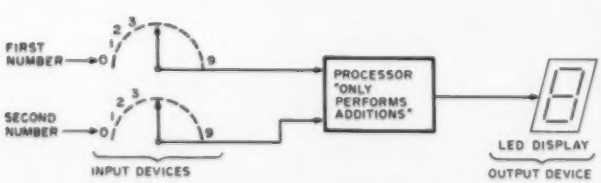

Fig. 2. Simple "addition only" cc.nputer.

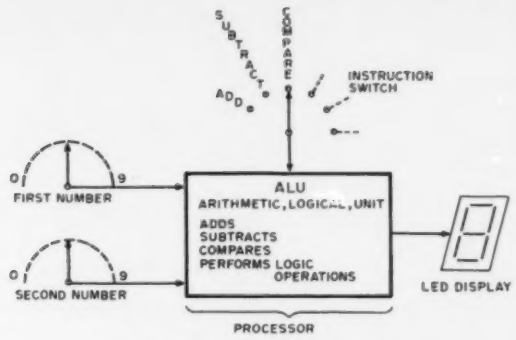

Fig. 3. Simple computer using ALU.

the numbers 1, 2, 3, 4, 5 are discrete values). The digital computer is not capable of handling continuous information. The reason for this is simple. The digital computer uses a series of "on-off" conditions to store information. The number "one" might be represented by an "on," while the number "zero" might be represented by an "off." But what about numbers such as .5? Can you have half of an "on" or half of an "off"? Certainly not very conveniently. Of course we could change our definition and let .5 be represented by an "on," but then how do you represent .55, .51, and so on? The point is that a digital computer can only handle discrete numbers, regardless of how we define those numbers. It cannot handle *all* numbers in a given range.

The frequency counter is an example of a digital computer. It accepts discrete pulses, counts them, and displays the results. In a given one second interval it cannot count 1/2, or 1/3, or .40497 of a pulse. It can count only discrete pulses.

What are the Components of a Digital Computer?

The typical digital computer may have numerous components with a rat's nest of interconnections; however, a fundamental digital computer requires only three pieces: an input device, a processor and an output device (Fig. 1).

The input device may be as complex as a graphics input terminal or it may be as simple as a single switch. The output device may be as complex as a video display or it could be a single small indicator. The processor could be very sophisticated, or it could be simple logic used to detect the simultaneous presence of switch closures.

As an example, consider a simple computer which has the sole function of adding two numbers in the range 0 to 9 together and displaying the output on an LED indicator. The block diagram of this simple computer is shown in Fig. 2.

This simple computer is a fixed function computer and can do only one function – add. The limitations of this computer should be apparent. It has a small range (0-9), cannot perform other arithmetic functions, and cannot compare two numbers for equality.

We could expand the capabilities of our processor by exchanging the simple "addition box" for an ALU (arithmetic, logical unit). This ALU type of processor is a readily available unit and offers additional capabilities such as subtraction, comparison of two numbers for equality, and logical operations such as "and" and "or." The simple configuration has now been expanded to that in Fig. 3 by the addition of an extra switch, an "instruction" switch, and by using an ALU for the processor. By varying the position of this switch, the various "instructions" could be selected. We could perform any of the allowable operations on our two "input" numbers and have the results displayed on the LED indicator. At this point, the fundamental computer has additional capabilities, but still does not have enough capability to be really practical. The ALU by itself can only process two independent numbers at any given time. It is not capable of simple steps such as adding a column of ten numbers, let alone complex problems involving many steps.

If our problem was to add a column of ten numbers, we could expand the fundamental computer still further by adding some device to store the column of ten numbers. The device could be connected to the processor in such a manner that the ten numbers would automatically be added. This storage device could be in the form of ten sets of switches, a tape recorder, a rotating magnetic disk, a series of magnetic cores or a series of electronic storage locations. A storage device in one of these classes is commonly called a memory. Note that a memory can be of several forms and is not limited to magnetic core or electronic storage. (Note: One of the earliest digital computers used a tank of liquid mercury as a delay-line memory.)

At the risk of appearing to go on and on forever, one last addition will be made to the fundamental computer system – an instruction memory. This instruction memory will serve to hold a series of steps for the processor and will give these instructions to the processor in sequence. A clock (in this example, part of the instruction memory) is used to generate pulses to step the instruction memory from one instruction to the next (Fig. 4). With this system we could command the processor to perform the following steps in sequence:

1. Add the first two numbers.
2. Add the last two numbers.
3. Compare the two sums.
4. Display the smallest sum.

Of course the sequence of commands could be endless. This simple computer system has a lot of versatility and could be very useful. (An example of this type of "programmable" computer is a programmable calculator.) The process of setting up the instructions for the computer is called *programming.* The computer as it follows the programmed instructions *executes* or *runs the program.*

A Real Life Computer

A real life computer does not differ much in logic or function from that shown in Fig. 4; however, the ALU is usually expanded to provide additional capabilities, and additional circuitry is usually provided to simplify input/output as well as to facilitate

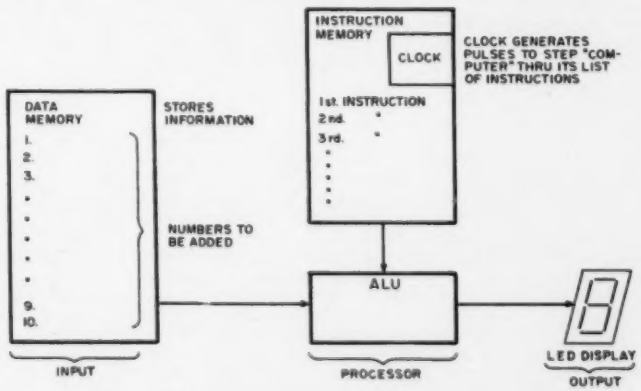

Fig. 4. Computer with memory.

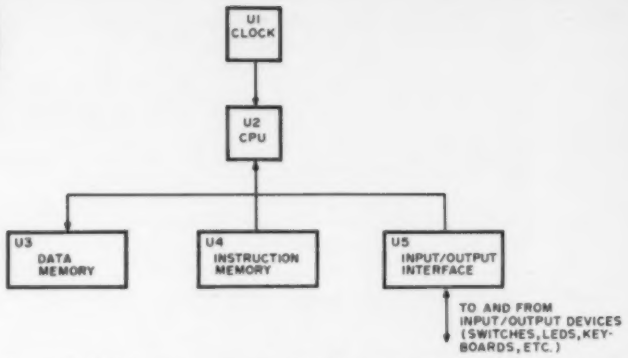

Fig. 5. "Real life" computer. U1 = 4201 clock chip; U2 = 4040 CPU chip; U3 = 4002 random access memory; U4 = 4308 read only memory; U5 = 4207 (4209, 4211) general purpose I/O.[2]

the flow of information and instructions within the system. While this last statement may sound like a "zinger," it is not, since a device called a "CPU chip" (a single integrated circuit) in most cases contains the additional circuitry as well as the arithmetic and logical functions. A CPU chip (Central Processor Unit) is a very unique and versatile device and is commonly called a "microprocessor." Fig. 5 shows a block diagram for a typical, fundamental microprocessor computer system. The five blocks shown correspond to 5 integrated circuits. This is a real life system. An Intel 4040 microprocessor system could be built using just 5 ICs.

How Do I Get Started?

It is not difficult to wire five integrated circuits together to form a microprocessor system. It is difficult, however, to make the plunge without first acquiring some important fundamental knowledge. By gathering this basic knowledge first, you can better utilize your microprocessor and you are in a better position to correct a problem should difficulties be encountered.

Fortunately, a large investment is not required in order to get into computers. For a nominal investment in a power supply, a breadboard, and a handful of very inexpensive ICs, the experimenter can build up simple computer-oriented circuits to experience firsthand just how things work. While simple circuits will not duplicate all of the functions of a microcomputer system, the experimenter will be able to perform arithmetic and logical operations as well as store and retrieve information with simple memories. If the experimenter is able to understand these basic concepts and is able to duplicate simple experiments, then he should be able to build and use a microcomputer system. Future articles will explain some of these simple circuits and experiments.

The Next Step

Man works with numbers in the decimal system, while computers work with numbers in the binary system. Future articles will discuss number systems, will explain how to do arithmetic in the binary system, and will give procedures to convert from one number system to another. Several experiments have been designed using an inexpensive ($3.95) ALU chip to illustrate binary arithmetic. Future articles will also discuss logic, memories and input/output. ■

References

[1] *Computer Dictionary and Handbook,* C. J. Sippl, C. P. Sippl, Howard W. Sams & Co., Inc., 1972, page 99.

[2] *MCS-40 User's Manual For Logic Designers,* Intel, Santa Clara, CA, 1974, pages 3-4.

I/O

from page 67

fantastic art forms by plugging into a color TV set . . . and there is a rapidly growing group of people working on computer art.

You can program your computer to compare any input against a desired data. You might tune in the Congressional Record on RTTY and set your system to check for certain key words such as Amateur Radio . . . and whenever this came up in the text your teletype would start printing.

Or perhaps you'd like to have your system switch your 2m receiver through all of the local repeaters constantly, checking for anyone sending a certain series of tones which would be your calling code. You get the picture.

CASSETTE I/O STANDARDS

One of the least expensive bulk memory systems so far available uses the garden variety cassette recorder. Those 4K and such memories in the computers are used to sort out and process data in the computer . . . the system still needs some place to store data for later use. The data may be programs to get the computer to play certain games, it might be names and addresses for a mailing list, book or record lists for an index, etc.

Eventually we will have other bulk memory systems which are reasonably low in cost. At present a floppy disk memory runs around $2000, which puts it rather in the expensive area for most home systems. A disk can hold around 250,000 bytes of memory and make it available within a few microseconds . . . good business if you are going to sort data or want quick access to random things.

Regular computer tape drives are not cheap . . . yet. They use half inch tape (usually), and cost $2000 or so, too. They can hold a lot more memory, but the time required for searching through the tape is much longer. There are some quarter inch tape cartridge systems in evolution which may be low in cost for home computers, but nothing is yet ready.

All of which brings us back to cassettes.

When I began to get an understanding of what was involved I looked to see what standards were being used for putting information on cassettes. I found, much to my horror, that there seemed to be as many standards as there were firms coming into the field. This would never do! We needed one standard for cassettes so that any program or memory cassette would work in any system regardless of manufacturer.

Since there was no one else to tackle the problem, I figured it might as well be me. I sent letters out to everyone in the industry that I knew about suggesting a meeting of everyone involved on neutral ground. I picked Kansas City because that was equally far away for everyone. I scheduled the meeting for November 7-8th.

The meeting came off right on schedule and just about everyone from the microprocessor industry turned out for it. At first the meeting got off to a very slow start and it looked as if no agreements would be possible, but (as I suspected) the spirit of cooperation won out and everyone finally got together and hammered out a standard which was agreeable to all.

The standard calls for two tones to be used, a mark tone at 2400 Hz eight cycles long for logic one and a space tone 1200 Hz and four cycles long for logic zero. A recorded character will consist of a space (start) bit, eight data bits, and two or more mark (stop) bits. The eight data bits are organized with the least significant bit first and ending with a parity bit, if used. All unused bits will be mark tones . . . e.g., the three unused bits when you are sending five level data. Mark tone will also be used in between characters as fill.

This system will give you about 47K bytes of data on a 30 minute cassette (one side of a C-60). If you use all four cassette tracks that would add up to almost 200,000 bytes. To put that in terms of an application, figure that you are putting names and addresses on the cassette. If you take 80 bytes for each name and address (which is what we use for the *73 Magazine* subscription records), this would permit you to have over 2000 names and addresses on a single cassette. That's a hefty amount of storage. If you are going to use an inexpensive recorder you would probably only put half that much on it since you would only use one track each way . . . but 1000 names isn't bad!

DO YOU REALLY WANT ASCII?

One of the questions I get a lot at hamfests has to do with when I think the FCC is going to okay ASCII for use on the ham bands. In due time I asked about this and got the news that there hadn't been a lot of worry about rushing ASCII because there had been very little demand for it to their knowledge.

It is the squeaking wheel that gets greased, to again coin a phrase. If you want to use ASCII on the bands, as what reasonable amateur wouldn't, you would do well to keep after the big candy store. Write them about it. Better, ask for "Special Temporary Authority" (STA) to try out ASCII and then get busy with it and pepper the FCC with reports on your fantastic results.

If we have to translate everything from ASCII to Baudot or Morse Code to send it we are hobbling ourselves as far as modern communications is concerned. ASCII is the standard and it should be permitted on the bands, so get busy.

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If you have a question about Altair hardware (whether or not you are a **Byte'Tronics** customer), we will put you directly in touch with our Technical Director, Hugh Huddelston. Hugh is an expert troubleshooter who has a thorough knowledge of each portion of each Altair board. And he can answer all your questions about custom interfacing.

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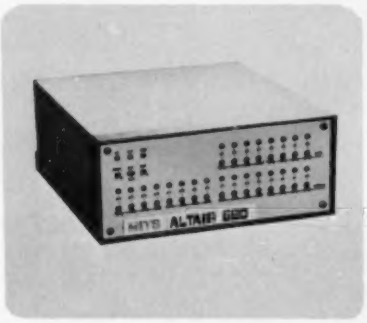

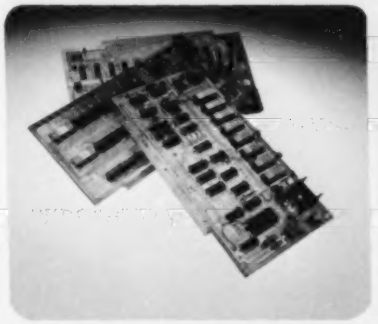

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by
Arny Cain WB4FDQ
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The IC See-er

Having been a dedicated ham and/or electronic freak for upwards of forty years (I was born in 1920, so you figure it out), I feel that I can speak with some authority on the subject of home construction of electronic projects. Unlike an engineer pal of mine whose motto is, "Never build it if you can buy it," I have one which is, and has always been, "Never buy it if you can build it." I have a shop full of electronic residue to prove it – and some of it even works.

Until recently I thought that I had run into every form of frustration possible in the genre – that is, until I started (about six months ago) my love/hate relationship with the ubiquitous integrated circuit. It is my considered opinion that no invention in electronics since the galena crystal and cat's whisker (and I can remember them, so how's that for dating?) has caused as much fumble-fingered cussing and soldering iron-induced frustration as the IC. Well, since I have always wound up spending more time building the tool to do the job than on doing the job, here is a gadget that will cost you less than ten bucks to build (using all new parts), will cure all of the abovementioned evils and will take the hate out of love/hate.

Yeah, I know that there is an outfit that builds a better one, but this is for guys like me who wouldn't buy one even if we could afford the fifty bucks.

As you can see in Photo 2, I built it in a 7" x 7" x 2" aluminum chassis. The lens is one of a pair of condenser lenses from a long since defunct 4" x 5" Omega enlarger. These little tidbits are six and a quarter inches in diameter and weigh in at about two pounds apiece. I'm waiting for a seven inch plastic lens to arrive from Edmund Scientific, so I can build a new improved version and maybe sell Wayne another article.

Photo 1.

I think that it will be obvious from the explanatory photos (2, 3, 4) that a collar was fashioned (six inches in diameter by two inches deep) from scrap, medium hard aluminum, to hold the condenser lens in place in the chassis (after cutting a six inch diameter hole in same).

Photo 2.

Photo 3.

Please take note (Photo 3) that I do not own a fly cutter large enough to cut a six inch circle, so I fell back on the old-fashioned method of drilling a series of small holes and chiseling away the metal between them. Since aluminum chassis are soft, it goes rather quickly, and the whole operation took me less than ten minutes using a drill

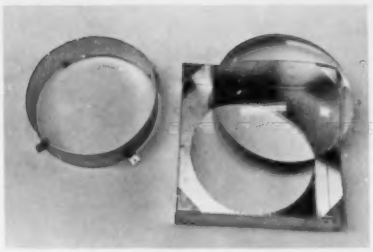

Photo 4.

press. If you have to use a hand drill it will pay you to center punch at proper intervals so that you will not mess up your nice new chassis. After you have the circle cut, a half round file will dress the rough edges easily. Before I forget, I split a piece of spaghetti tubing lengthwise and used it for an edge liner around the hole. A spot or two of glue and the pressure of the lens keeps it tight, and it makes a very professional looking finish.

I drilled holes in the sides at the point of balance and inserted three-sixteenth inch bolts and nuts for the side supports. By adding wing nuts and lock washers, I created

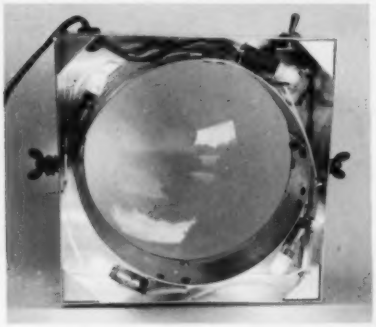

Photo 5.

an easily adjustable mount. Two pieces of 1/8" x 1¼" x 7" aluminum from an old panel were used for side supports, and I bolted them to a scrap plate of 5/32" x 8" x 8" metal that has been kicking around the shop for years. As you might suspect (and as my XYL will tell anyone who will listen), I never throw anything away, and this base is the living proof that it pays.

I must admit both that I should live in a barn and that my wife is a living, breathing saint (direct from the Old Testament) for putting up with me. Actually, the mounting of this gadget can be done any number of ways and this was just the easiest and quickest, considering the weight of the lens. Besides, I was in a hurry to finish as I had a project waiting to be soldered and I wanted to give the IC-See-er a workout.

Now for the novel lighting arrangement (Photo 5). As you can see, there are four pilot light sockets fastened at equally spaced intervals around the outside of the retaining ring collar. If you decide to go my route on this, I want to give you a word of caution right now!

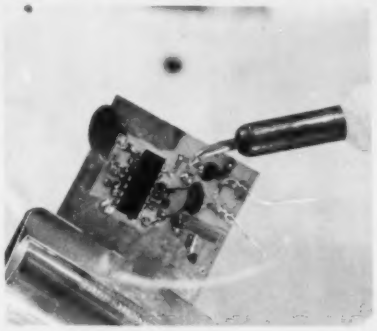

Photo 6.

Make damn sure that the sockets are well insulated from each other and from the metal collar that they are mounted on, 'cause what I did was to wire them in series and hook them across the 115 V ac line with a switch to turn them off and on. The bulbs are Tung-Sol #T313, 28 volt, bayonet base pilot lights. Twenty-eight times four equals 112 volts, and hooked across 115-120 this gives a not brilliant but very pleasant and quite adequate light for close-up work.

An additional bonus is the high-priced PC board vise (always give them a little extra for their money). It will be obvious that this added luxury feature is the really expensive item of the project, since chromed two inch

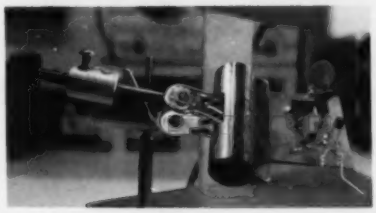

Photo 7.

Photo 8.

paper clamps are selling in our inflated economy for the munificent price of twenty-seven cents each. I splurged and bought four, so that I would have extras for a vise to hold larger PC boards. The rest of the stand is made, as is shown in Photos 7 and 8, from odds and ends of ¼" shafting and old shaft collars, plus some assorted scraps of aluminum and radio hardware.

It took me about two hours to build this little gadget and, quite honestly, every ham/experimenter who has been in the lab has tried to steal the damn thing right off of the bench, with me watching yet. Suffice to say I would not part with it for love or money.

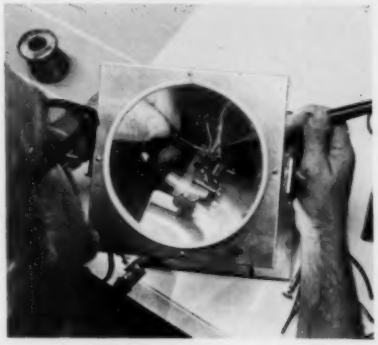

Photo 9.

The one fault it has is that I made the support legs a little short. Still, it is doing a heck of a job for me and in retrospect I don't know how I survived so long without it. I have also built myself a little device for holding my small (37 W) soldering pencil and controlling the heat of same – that no one who works with ICs should be without – but this is just a plug for another article.

Build yourself an IC-See-er and you can also wonder how you ever got along without one. ■

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Build This Exciting New TVT

by
Louis I. Hutton K7YZZ
12235 SE 62nd Street
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About a year ago I decided to reactivate the RTTY mode of my station, and this article is a description of two of its facets: the keyboard and the television terminal. The keyboard development went reasonably well; then came the television terminal for RTTY, which I call the "RTTY TVT" for short. I immediately found that almost no data has been published on such a unit, with the closest thing being the computer TVT video readout devices. This problem was discussed at length both on the air and by mail with Dr. Robert Suding WØLMD, who suggested that I see what could be built using a low cost TVT circuit board kit designed by The Digital Group[1].

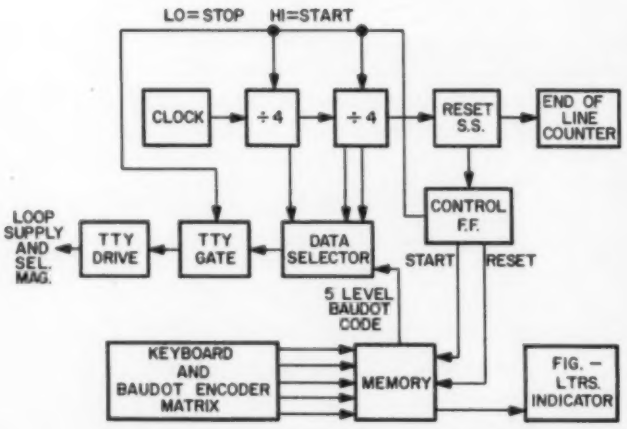


Fig. 1. Block diagram of RTTY keyboard.

PART ONE
KEYBOARD

Several years ago I acquired a Model 15 Teletype machine, built up a tube type terminal unit, and enjoyed many years of operation with the green keys. This equipment was retired recently and a new project was begun to update the RTTY equipment. A 100 speed Model 28 KSR was acquired and the experiments begun. This article presents an effort undertaken to build a "solid state" version of the Model 28.

A literature search was conducted to find out what has been written with regard to the design and construction of a solid state keyboard for RTTY. A RTTY keyboard using the old RTL ICs was found in an article by Krupp several years ago, and in another by Horowitz about a CW keyboard modified for RTTY operation. Another article by Bell and Schmidt was located which presented a pre-coded message on RTTY. These articles gave me some ideas on how I wanted to design my solid state keyboard for RTTY.

The unit described in this article will permit the operator to generate the RTTY Baudot code at 60, 67, 75 or 100 wpm. It features LED indication of End Of Line, Figures or Letters mode of operation. As a result all fancy frills and extras are not provided, just a keyboard, using the 7000 series TTL IC chips. This is one of the advantages of building it yourself – no unwanted expensive extras.

Circuit Description

A block diagram of the unit is shown in Fig. 1. The clock speed is manually switch selected from 60 to 100 wpm speeds. The

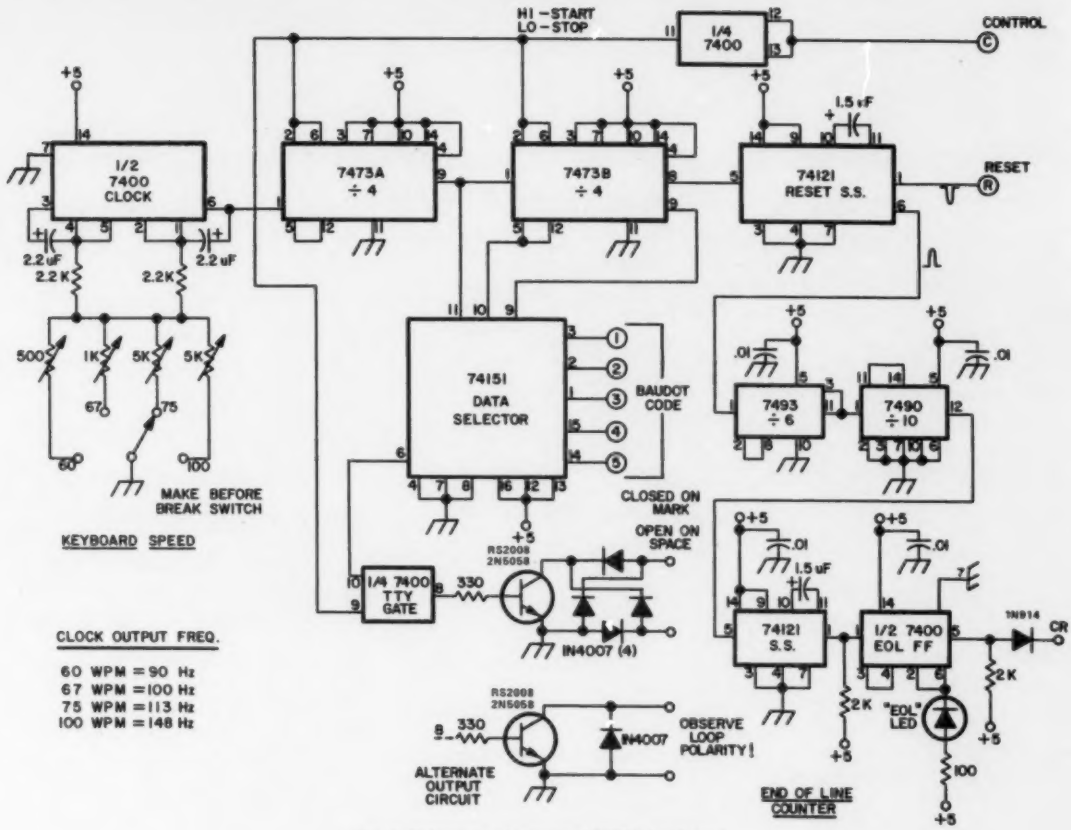
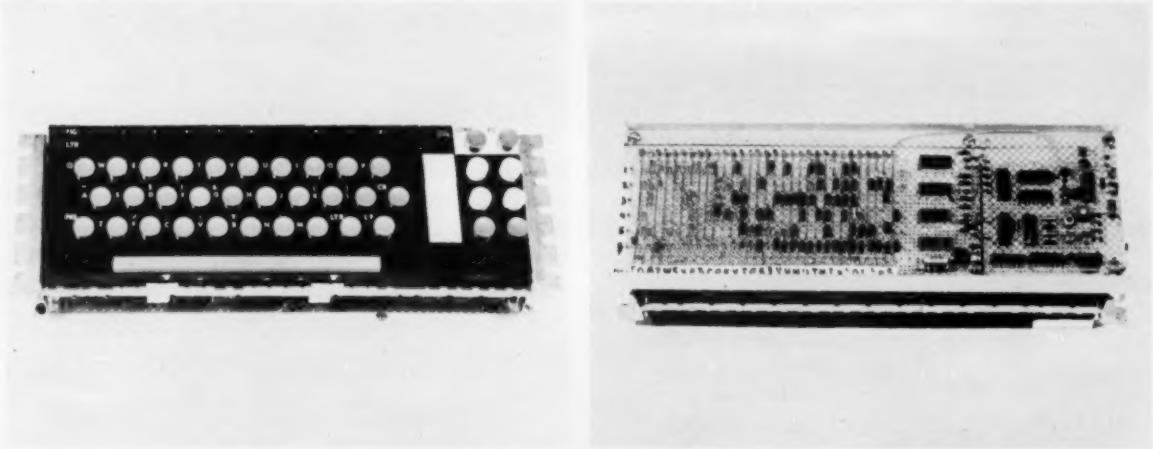


Fig. 2. Schematic diagram of RTTY keyboard.

output of the clock (90.0 Hz at 60 speed) is fed to a frequency divider chain. The three frequencies taken from the divider at 60 speed are 22.5 Hz, 11.25 Hz and 5.6 Hz. These three are fed to the Data Selector which acts like an electronic version of a TD (Terminal Distributor). When a key is depressed the Baudot code for that key is set up in the Memory flip flop via the diode matrix. The output HIs and LOs from the Memory are fed to the Data Selector. A start pulse from the keyboard is also sent to the Control FF which unlocks the frequency divider chain and the RTTY Gate. For 176 ms (at 60 speed) the frequency divider chain transmits the selected frequencies to the Data Selector which then reads out the RTTY code set up in the Memory. This code consists of a series of 22 ms pulses: one start pulse, five Baudot code pulses and two stop pulses. At the end of the pulse train the Reset SS fires and the Control FF is reset. This action clears the Memory FFs and stops the divider chain from counting any further clock pulses. The RTTY pulses are fed from the RTTY Gate to the RTTY Drive output stage which is in turn connected to a diode



Top and bottom views of solid state RTTY keyboard.

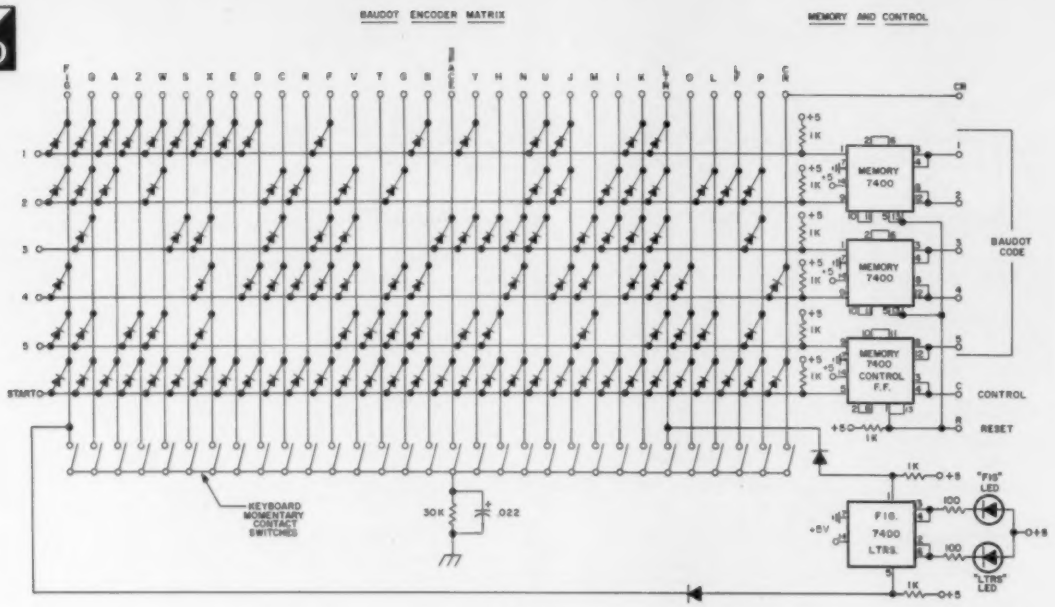


Fig. 3.

bridge permitting connection to a loop supply of any polarity. The End Of Line counter is used to indicate when 60 keyboard actions have been taken after a Carriage Return function has been keyed. This is used when the keyboard is used for driving a tape puncher. When the FIG key is depressed an FF is set and the FIG LED is lit. When the LTR key is depressed the FF is reset and the LTR LED is lit. Depressing two keys simultaneously will cause an error in the output. No mechanical or electronic means are provided in the low cost unit to prevent this event.

Construction

A surplus computer keyboard was purchased from a surplus house that advertised in *73 Magazine*. This unit uses magnetic reed switches and has plenty of extra keys for other functions that are planned for in the future. The key tops were removed and the computer markings replaced with decals of the standard RTTY upper and lower case markings. Since the keyboard already had a very nice set of numbered keys I put them on the top row, which made it not quite like a Model 15 or 28 but a bit more like a typewriter. Again, with home brewing you can make it to suit yourself.

Two metal rails were formed and attached to the bottom of the keyboard unit on metal spacers. A long piece of perforated fiberglass board 4" by 8½" was fitted in between those two rails as seen in the photographs. The diode matrix, Memory, Control FF and FIG/LTR FF were mounted on that circuit board. This configuration permitted me to conduct circuit design and debugging on a second small board containing the remainder of the circuits. The second board is 4" by 3¼". If one wishes, a board 11¼" long by 4" wide could be used for all the circuits, now that the unit has been designed. The ICs are fixed, mounted and hardwired into the circuit. Since this is not a production item no effort was made to design a PC board.

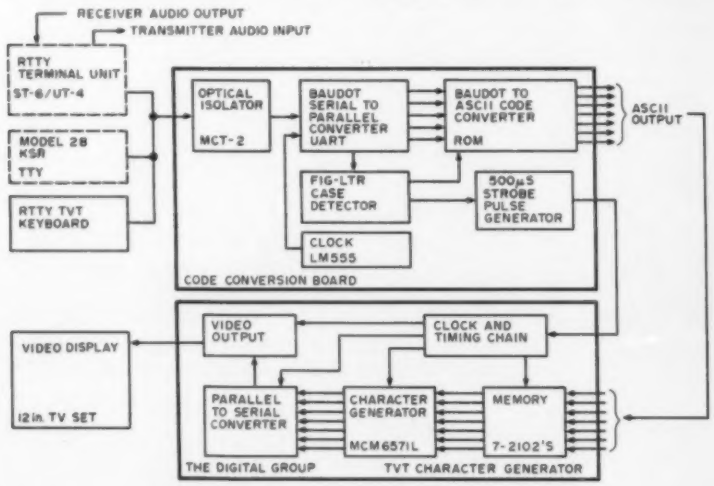


Fig. 4. Block diagram of RTTY TVT.

Testing

The long circuit board was wired first, and a manual jumper was wired from the keyboard key grounding capacitor and resistor to test out the diode matrix and memory before wiring keys in the circuit. A jumper was wired from the reset line on the memory that was momentarily grounded to reset the memory. The wire from the key circuit was touched to the selected diode matrix letter and then the five Baudot output lines were checked for proper high and low states. Each diode in the matrix represents a mark or high state. The absence of a diode represents a space or low state.

The diodes used in the matrix were of the fast switching type used in computers. I used some obtained from Radio Shack which carry their part number 276-114. They come in a bag of 50 each and must be tested.

When checking out the small circuit board the first thing to test is the clock. I monitored the pin 1 of 7473A to see if the clock was oscillating in each position of the speed selector switch. That switch must be of the make-before-break type for proper

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The RTTY TVT.

operation of the clock. Each adjustment pot was set to give the proper speed according to the chart on the schematic. At 60 speed, 90 Hz should be appearing at pin 1 of 7493A, and with the control line high at pins 2 and 6 of each of the 7493s you should get 45 Hz at pins 5 and 12 of the 7493A. Pin 9 should be 22 Hz. Pins 5 and 12 of the 7493B should be 11 Hz, and pin 8 of the 7493B should read 5.5 Hz. A negative going pulse of around a half a millisecond should be seen reoccurring each 176 ms on pin 1 of the 74121 Reset SS. With a temporary ground on pins 2 and 15 of the 74151, the output as monitored on pin 6 of the 74151 should read low, high, low, high, low, high high, repeat, etc., in a serial bit stream. If a temporary ground is placed on pins 2 and 6 of the two 7473s the bit stream should stop. If all works OK at this point, then remove all the temporary wiring and wire the board in the circuit with the encoder board.

As a final test I wired the output in series with the loop supply and printer magnets of my Model 28 KSR and was able to type out a copy on a local loop using the keyboard and the Model 28 printer at 100 speed. I ran into some noise problems and had to add some power bus bypass condensers on several of the ICs, and these are so noted on the diagram.

This unit was a very interesting project and it was a very good feeling when I finally got it assembled and running with my printer. The circuit development took several months of breadboarding to get all the various parts of the unit tested before tying them all together in the finished product. I wish to thank Mr. John Small and

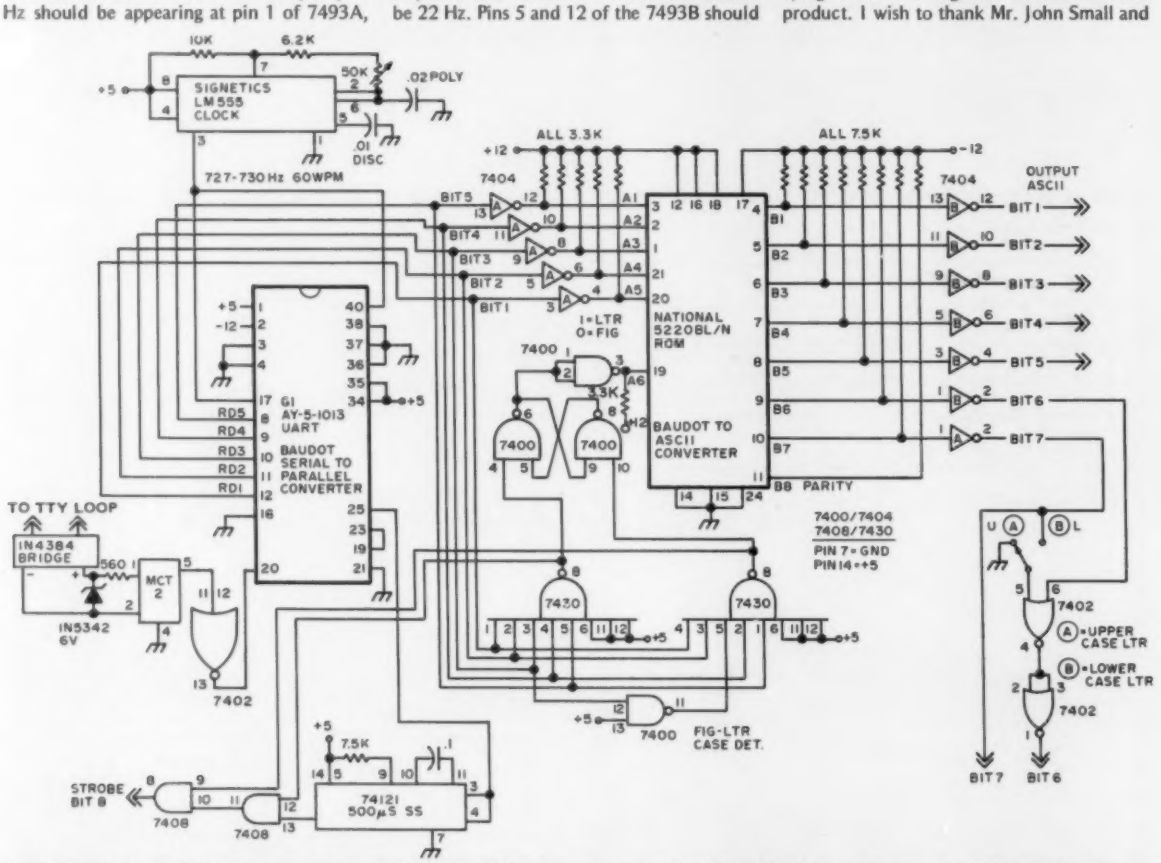


Fig. 5. Baudot to ASCII TTY code converter. Note: If FIG-LTR state on pin 19 (5220 BL/N) is incorrect, rewire 1-2-6 of 7400 to 1-2-8 of 7400.

Mr. T. Jackson who were most helpful in keeping my thinking straight as I developed this unit.

PART TWO
TELEVISION TERMINAL

There are two approaches to getting that RTTY signal on a TV set. One way is to make the keyboard output the ASCII code so that it could talk to the TVT without any conversion. This method also requires both send and receive code converters to get the Baudot code converted over to ASCII to be compatible with the display. Also, when you send from your ASCII keyboard it must be converted to Baudot so the other chap's machine can print the message. The second approach is to use a keyboard that only sends in Baudot and make only one conversion from Baudot to ASCII so that the TVT could read the incoming signal from either the keyboard or the terminal unit. This is the approach that I used, and the results of my efforts are described here.

This unit includes a surplus keyboard rebuilt to include a diode matrix for encoding and generating the Baudot code at 60 wpm. The output of this keyboard is used to key the ST-6 loop and the TVT through a code converter board. This circuit board converts the Baudot encoded bit stream coming from the ST-6 or the keyboard from serial to parallel Baudot data. The parallel Baudot data is then converted into parallel ASCII data and a strobe pulse is added to trigger the TVT display circuit. The parallel ASCII is fed to the character generator circuit board and onto the TV screen. The display has eight lines of thirty-two characters per line. When the last character is printed at the bottom right-hand side of the screen the printout returns to the upper left and erases the existing character and prints the new one as it progresses across the screen line by line.

A HOME push-button switch is provided that will return the writing beam to the upper left-hand corner of the screen. An upper and lower case letter selection switch is also provided as that feature is available in the TVT circuit board by The Digital Group. Since this board was used in a microprocessor computer terminal, it has Greek notations which cause some glitches in the Baudot scheme of things. These were most troublesome in the FIG and LTR modes. The code conversion board has circuits incorporated to tell the character generator to ignore those key functions in the Baudot system. All other frills and extras were left out of this terminal to keep the cost down. It is estimated that one could probably be duplicated for anywhere from $250 to $350 depending on how many surplus components were used.

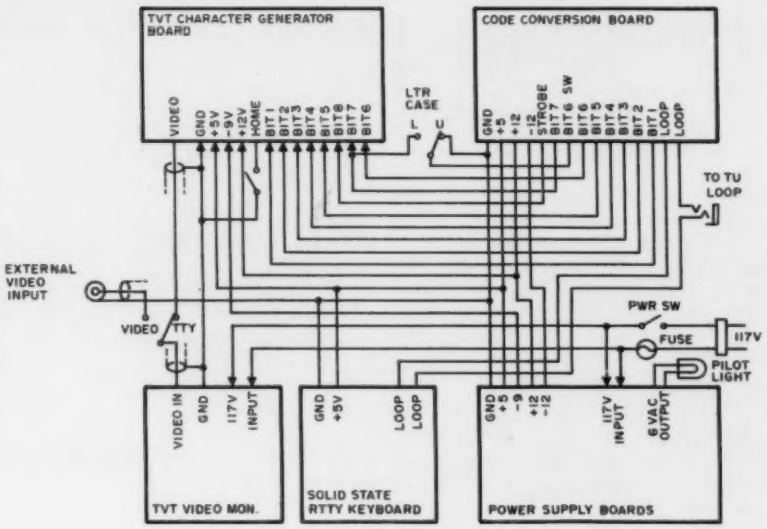
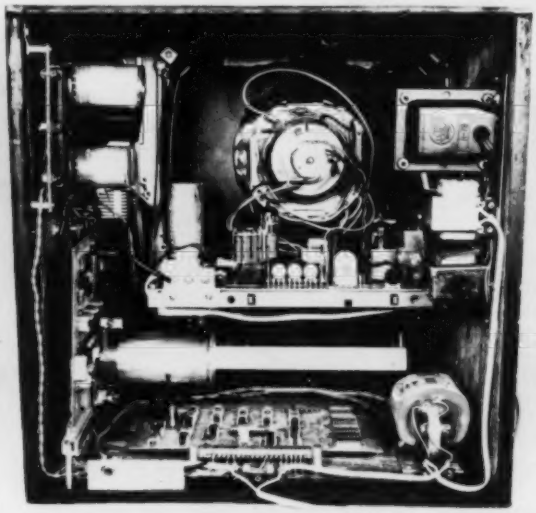


Fig. 6. Intercabling diagram.

Circuit Description

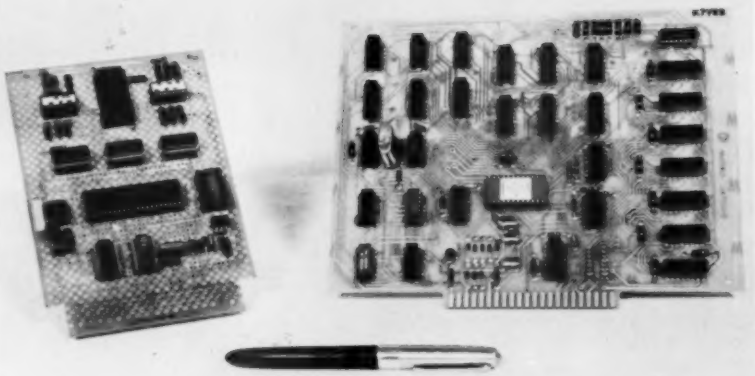
A detailed description of the design and operation of the keyboard has already been presented. A block diagram of the RTTY TVT is shown in Fig. 4. The input to the code conversion board is made to the ST-6 loop circuit through an optical isolator to keep the loop high voltage from the five volt TTL circuits. An UART (GI AY51013) is used to convert the serial Baudot to a parallel Baudot output where it is fed to the input of a code converter ROM. The clock (LM555) for the UART is set for 60 wpm speed (727 to 730 Hz). In the code converter, a National 5220BL/N ROM, the Baudot code is changed to the ASCII code.[2] A figures-letters function detector is used to tell the code converter to include either bit 6 or bit 7 in the ASCII code output. The case detector is also used in conjunction with the strobe generator to eliminate the Greek letter that would normally appear on the TV screen when the FIG or LTR key is touched. A strobe of at least 500 microseconds is required at the end of the generation of each character on the TV screen. The strobe generator is triggered by the output of the UART transmitter section.

The ASCII output, along with the strobe line, is connected to the TVT character generator board. The video output from the TVT board is connected to the video input of a modified TV set. To prevent the TVT display from returning to home position after every time a CAR RET is keyed, IC30 (7430) is removed from its socket. A 2.2k pull up resistor is connected between pins 8



Internal view.

and 14 of the IC30 socket. A wire is run from pin 8 of IC30 socket to pin 14 of the PC board connector. This is the reset "HOME" terminal. When this terminal is grounded momentarily via a push-button switch it drives the write beam of the CRT to the beginning of the first line on the display. This is the only modification required to The Digital Group TVT circuit board to get it working as a RTTY TVT circuit board. The video readout of the RTTY TVT unit is a salvaged 1969 Sears 12" portable TV set. This set came from a junk yard, and to put it into use as a video monitor all the circuits were removed except the sweep, video and high voltage. It makes a very acceptable video monitor for this application.



The two PC boards.

Construction

The cabinet for the RTTY TVT is constructed from plywood and is 15" high by 15" wide by 15" deep with about 4" sticking out in front to house the keyboard. The outside of the cabinet was sanded and given two coats of shellac. The edges of the cabinet were painted a dull black. The remainder of the exterior of the cabinet was covered with simulated wood grain sticky-black plastic covering obtained from a hardware store. This makes a really nice looking cabinet. The panel holding the keyboard was also covered with this same simulated grain material. A metal panel was fitted over the holes left by the removal of the TV tuners and controls, and was covered with the simulated wood grain material.

The power supplies were constructed from surplus parts and are mounted by metal standoffs to the inside of the cabinet. The circuit board containing the code conversion circuit is 4½" wide by 6" long. The TVT readout board is 8" wide by 6½" high. A diagram of the code conversion board is shown in Fig. 5. The overall intercabling diagram for the RTTY TVT is shown in Fig. 6.

The conversion of the 12" TV set for use as a video monitor required considerable time as the set was in pretty bad condition. The filaments of the four tubes used were rewired so that they would work from lower voltage circuits. I did not want to run the thing from the power line direct like it was originally wired. I used a small isolation transformer to supply the 120 volts for the power supply input. I found that both the yoke and flyback transformers were defective and had to be replaced using parts from other discarded sets. Fig. 7 is a schematic of how I accessed the input to the video amplifier of the rebuilt set. The original set used a tube to rectify the high voltage to the picture tube and I replaced that with a solid state high voltage rectifier removed from another junk set. This helped to further lower the current drain on the set. The front part of the old set's cabinet formed the front of the TVT unit. It was attached to the plywood cabinet by hand-made metal brackets. The panel to the right of the picture tube contains all the controls for operating the RTTY TVT. These are the pilot light, power switch, video monitor or RTTY monitor selector switch, upper case-lower case letters selector switch, and the HOME switch. The CRT brightness and contrast controls were mounted on a small metal plate fastened to the rear of the TV chassis. They are set once and left that way.

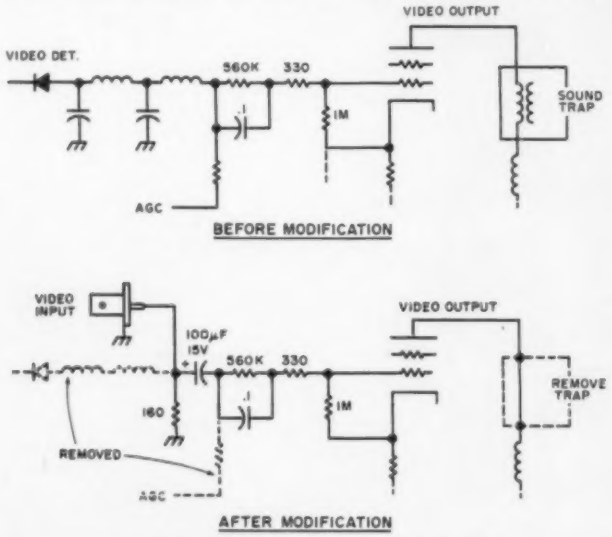


Fig. 7. Video input modifications to 12" TV set.

Test and Checkout

Since I was developing many of the circuits to put this thing together, I ended up by running all sorts of tests during that time. Many of them are not needed for someone essentially duplicating this circuit. When the code conversion board is finished, the input to the board should be connected to the output of the keyboard and the ST-6 or terminal loop supply. This way you can send Baudot encoded characters to the board one at a time to see if they are being encoded properly at the output of the board in the ASCII code. The clock must be set for an output frequency of from 727 to 730 Hz as measured at pin 3 of the LM555 (60 wpm). Each time a key is depressed on the keyboard a pulse of approximately 500 microseconds should appear at pin 8 of the 7408 gate. There should be no pulse appearing at that point when the FIG or LTR keys are keyed. A "high" or 1 should appear on pin 3 of the 7400 when the LTR

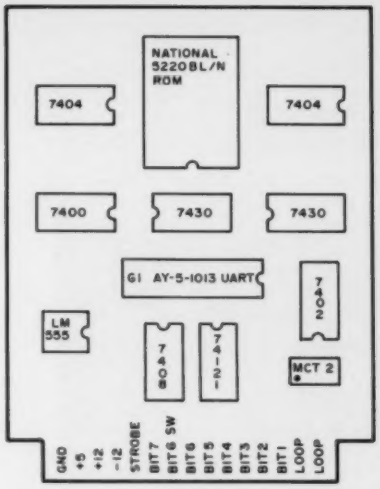


Fig. 8. Major parts layout, Baudot to ASCII code conversion board.

key is depressed, and a "low" or 0 should appear on pin 3 of the 7400 when the FIG key is depressed. Pin 5 of the 7402 should be temporarily grounded so that the output of the code converter may be checked.

Key in the letter A on the keyboard. Now look at the output of the board and bit 1 and bit 7 should be high and all other bits low. Now try the letter R on the keyboard. Only bits 2, 5 and 7 should be high on the ASCII output. Now try the letter Y and the ASCII readout should have 1, 4, 5 and 7 high. Now key the FIG key and then the number 2. The ASCII output should have only 2, 5 and 6 high. On FIG operation bit 6 of the code is used and on LTR bit 7 is used. If at this point you are getting this kind of response on the ASCII output you are in fine shape. The next thing is the character generator circuit board.

The circuit board data furnished by The Digital Group with their TVT character generator gives very detailed step by step instructions on how to check out their board and will not be repeated here in this brief article. I had an old 1950 Admiral TV set that I had previously modified for use as a video monitor with a camera for fast scan to slow scan conversion construction project. I used this set to test out the TVT board and to check out the system from keyboard through the code converter through the TVT board and onto the TV set. This way I was sure all bugs were worked out before I mounted the parts in the cabinet. The TVT circuit board performed as designed with only a slightly defective memory chip giving me any problem. This bad chip caused the wrong character to appear in certain lines on the screen. When replaced by the vendor it worked perfectly.

When connecting the input of the RTTY TVT into my ST-6 I had a polarity problem and had to reverse the input leads to the RTTY TVT to get it to print properly. This was the only interfacing problem encountered. I have my Model 28 KSR wired in series with the loop driving the RTTY TVT and if I want a hard copy I just turn on the power switch on the machine motor and the copy is printed.

I would be interested in hearing from those who decide to build one of these RTTY TVT units and will try to answer any questions they may have about the machine. All I ask is that they include an SASE. 73s and good printing on your CRT. ■

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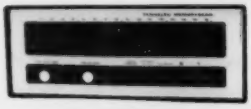

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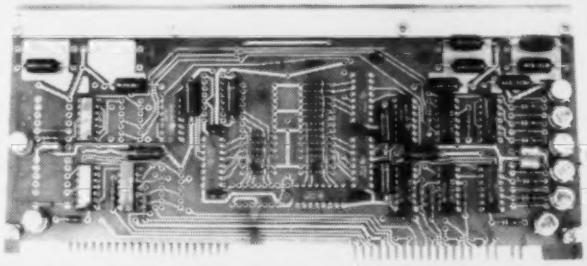

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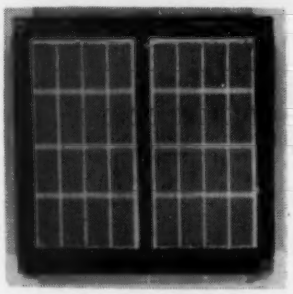

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Magic Fingers for RTTY

If you have speedy fingers, never have RTTY problems (ha!), or have built your last perfect RTTY AFSK unit and have it all tuned up, more power to you. If, however, you are like most of us and have two thumbs per hand, a Model 19 that periodically has spasms of TIN-GT's (this is not *&#% going to's), or ever experiment with building new ideas in AFSK gear, you can sure use the item I am about to describe.

I think the circuit to be described, when coupled to a tone source, is the handiest gadget I have ever built for RTTY. It gives you any RTTY character or the RY test combination automatically repeated over and over. While you can use various tone sources, from a modified AFSK sending unit to the new tone generators like the 566 IC that is TTL compatible when run correctly, I highly recommend using the very accurate and stable tone source described in an article by Dr. Robert Suding WØLMD in the July 1975 *73 Magazine*, page 98. The generator is great and apt to be the starting point for many projects and articles of mine in the future.

Ever since I built the first one (I now have 3 in one form or another), I have been sold on the unit and keep building gadgets to put it to more use around my bench and ham shack. One is the unit to be covered in this article, another I have written up and built as an SSTV generator producing gray scale with sync, and the third will be forthcoming for use with touchtone equipment and repeater users may find it of interest. A fourth is in progress at the time of this writing for use with SSTV in the form of copying the weather satellites.

Project Outline

This little adapter unit will provide you all the RTTY tones (and SSTV) if you use it with the original tone generator by WØLMD. Further, it gives you automatic generation of the "RY" alternating letters used as a standard Teletype test because of its alternating Mark-Space format. For those just getting into RTTY, I am referring to the normal 7 part, 5 level code used by amateurs. All characters start with a Space tone from the "Mark-Hold" tone that keeps the machine (Teletype) quietly sitting there and not chattering away. Then the next five units are either Mark or Space, depending on the character sent. The final or seventh unit is always a Mark, usually sent 31 ms long (the rest are each 22 ms) to be sure some of it makes it through to end the character. Only a small part of the 22 ms units is really used, too, but all is usually sent to be sure of recovery in spite of fading, noise, etc. This unit uses all 22 ms units (often called Western Union because that is the format they use), the reasoning being that the unit

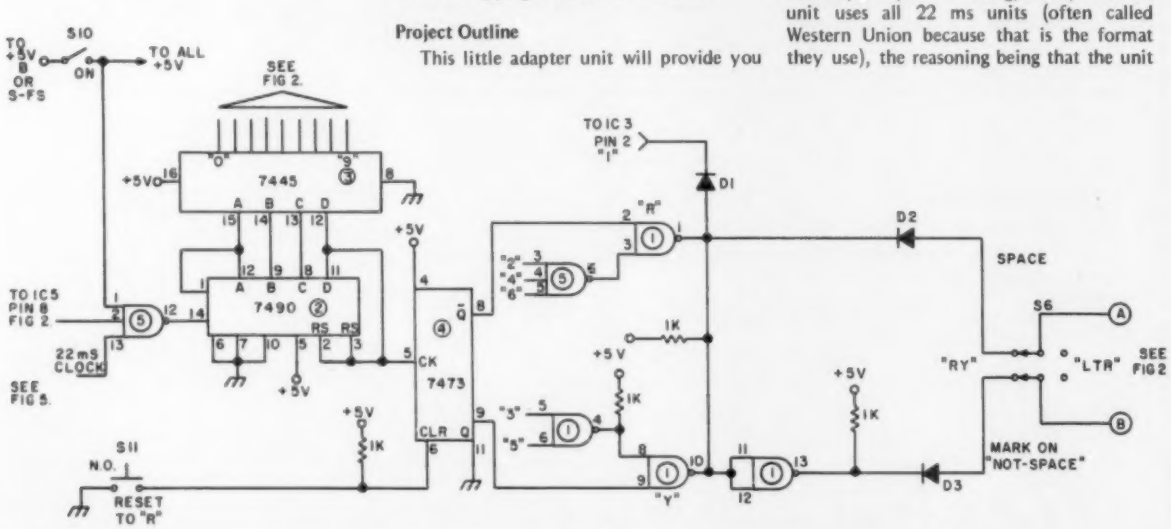

Fig. 1.

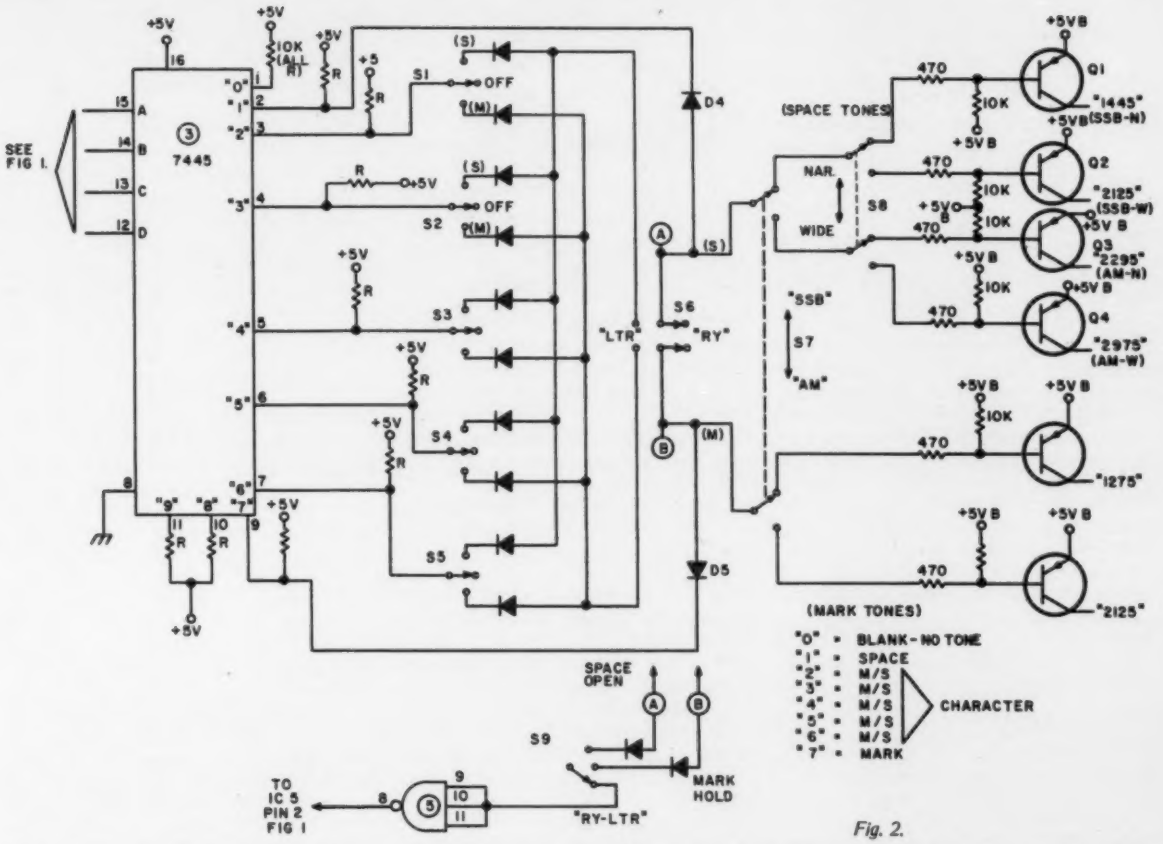

Fig. 2.

will be hooked right into the RTTY AFSK unit, and noise and fading are definitely not a problem in such a case. Secondly, it greatly reduces the hardware required.

A few words on switching are in order at this point. Switches added for the automatic character sending are: (1) S-1 to S-5, which are 3 position slide switches used to set up a character of your choice, to check out the TTY machine or one of the "SELCAL" type decoders if you are building such an item. Fig. 3 shows the actual slide switch form instead of functionally as in Fig. 2. (2) Switch S-6 is used to choose whether a "letter or figure" is sent or the "RY" pattern. (3) Switch S-7 is a DPDT unit marked "SSB-AM." What is really meant is whether the newer-lower tones that will pass through an SSB receiver filter are sent, or the older-higher audio tones used on AM type operation are chosen. (4) Switch S-8 chooses whether the older shift standard of 850 Hz wide (W) shift is sent, or the newer shift of 170 Hz narrow (N) is the result.

S-1 through S-5 are set up by using a chart of the required Mark-Space combinations for the character you desire. S-6 is set to "RY" for the automatic RY test, or to "LTR" for using S-1 to S-5 and a letter. S-7 and S-8 will depend on your use, equipment, and tones that you require.

S-9 is a function switch allowing a continuous Mark-Hold tone for 1275 or 2125 Hz Mark channel adjustments. It also stops the Teletype from chattering away while you change to a new letter or to RY combination. A second choice of S-9 is the Space-Open. The machine will run "open-loop" and chatter away if on, but you can adjust any of the four frequencies used for the Space channel depending on the setting of S-8 and S-7. The last position chooses the automatic mode, either "RY" or "LTR" depending on the setting of S-6.

S-10 is an on/off position to allow this unit to be used with the original tone generator when in the on position, and other gadgets to use the same tone generator when turned to off. In the off position, +5 V is removed from all +5 V points in the adapter except the electronic switches (transistors) used to key on the tone desired. The transistor emitters are supplied directly from the +5 V bus and have +5 V whenever the tone generator is on.

A word about the original tone generator as it applies to this adapter. All of the 7430 ICs with SSTV outputs can be eliminated if you want an RTTY only unit, thus reducing the overall cost. These ICs have SSTV frequencies of 1200, 1700, 1900, 2100 and 2300 marked at their outputs pin 8. The 7410 used to decode 1500 at pin 12, 1275 at pin 6, and 2125 at pin 8 must remain due to the two RTTY frequencies involved, but pins 1-2-12-13 need not be wired. The 7430 that has all the SSTV frequencies at its input can be eliminated and the 7402 pins 5 and 6 tied together. You may note that only half of the 7473 is used in the original tone generator, and you may feel free to use the other half for the RTTY adapter IC-4 by using the numbers shown in Fig. 1 and save some money.

Now that the unused ICs are out and the other half of the 7473 is used for the RTTY unit, you need only IC-1, a 7401; IC-2, a 7490; IC-3, a 7445; and IC-5, a 7410. A typical total cost of all these is $1.82. But you say, "Yeah, what about the tone generator?" If built as I described above for RTTY only, the IC cost for all ICs – tone generator, RTTY unit, and power supply IC – is only $6.45 plus $1.82, or $8.27. The power supply 309K is $1.95 of that cost, but I highly recommend its use. You must increase the power supply transformer to one with a 1 Amp rating, but that is the only power supply change.

My suggestion for wiring eliminates the switch in the original tone generator and replaces it with the electronic switches as shown. Each RTTY tone can be gotten alone or automatic mode is possible. If you choose to retain the SSTV mode, then merely rewire the switch as a seven position switch,

per the original switch for the first six positions A through F. (NOTE: The original Fig. 1 shows 2100 and E in position 6 which should be 2300 and F.) Then use Fig. 4 to wire up position 7. This allows normal SSTV use for six positions, and position seven puts you in RTTY function all with a single pole rotary switch and only +5 V being switched around.

Circuit Description – Logic

By placing a square wave with a 22 ms period into pin 13 of IC-5, and S-10 being on, the encoder IC-2 (7490) will begin to count. Its BCD lines are decoded in the decoder IC-3 (7445), and one line at a time from "0" to "7" goes low. The encoder and decoder is prevented from counting "8" or "9" by tieing the D line back to the encoder reset gate, resetting the counter as it tries to go to "8" (D-high). The D line is used for something else to be explained in RY generation. In the "LTR" mode of operation the lines "2", "3", "4", "5" and "6" cause Marks or Spaces to be generated depending on the settings of S-1 to S-5. Line "1" always generates the characteristic Space first unit, just as "7" always generates a Mark final or Stop unit. Switch settings as described decide what exact tones are generated for each.

RY Generation

The test pattern is a bit more complicated, but not greatly so if you break it down. IC-1 marked "R" can do *anything* only when IC-4 pin 8 is high. Likewise, IC-1 marked "Y" can only get a low output when IC-4 pin 9 is high. These two pins of IC-4 cannot both be high at any one time. Therefore, let us follow through an R generation, that is S – S - M - S - M - S – M (S = Space, M = Mark). Remember the first Space and the last Mark are put in for any automatic LTR or RY by lines "1" and "7" of IC-3, and won't be covered over again. The R is generated when IC-4 pin 8 is high, so let's start as though S-10 is turned on and then the "Reset to R" push-button S-11 is pushed. S-6 is in "RY" and S-9 in "RY-LTR." When the counter and decoder reach "2", IC-5 pin 3 goes low, IC-5 pin 6 goes high, and IC-1 pin 1 goes low. This low

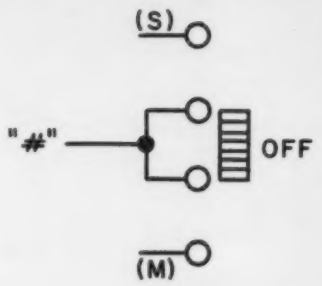

Fig. 3. S1-S5 switches: 1P3T. Center off position allows the generation of false characters to check logic-type decoders. It can be deleted and SPDT used if not wanted.

through S-6 and on through the chosen space frequency switch causes a Space tone to be generated. When advanced to "3", IC-1 pin 5 goes low, and pin 4 goes high, but since IC-1 pin 9 is low, IC-1 pin 10 stays high. Since both IC-1 pin 1 and pin 10 are high, and "1" is high (see D1 Fig. 1), all inputs to IC-1 pins 11 and 12 are high, and its output goes low causing an appropriate Mark tone for the switches S-7 and S-8 chosen. Diode D1, incidentally, defeats the Mark switch IC-1 pins 11-12-13, during the first "1" Space required by all letters and figures and is used in RY mode only. It appears to key the Space by the path through D2, but a better path is found through D4.

As the counter advances to "4", the same action as "2" results using IC-5 pin 4 instead of pin 3. Again at "5", the same as "3", using IC-1 pins 11-12-13 for a Mark. And finally at "6", again as in "2" and "4", using IC-5 pin 5. "7" sends its Mark as well as the low at IC-1 pin 13. This just happens to insure Mark sent when in RY mode only and is just a logic result and not intentional.

To generate a "Y", the same kind of logic applies throughout with "3" and "5" creating Spaces for the Y or S –M - S - M - S - M – M. The "3" and "5" control IC-1 pins 5 and 6, and function just as "2", "4", and "6" did into IC-5 pins 3-4-5. The one change is that following the generation of "R" above, the D line returning low and resetting the counter also sets IC-4 to the opposite state with the Q pin 9 high, and allows IC-1 pins 8 and 9 to control the tone generation. IC-4 (7473) continues to change state (toggle) after each pass of the counter to "8" and the D line falling from high to low. This is a narrow pulse just wide enough to reset the counter and toggle IC-4. The toggling of IC-4 produces alternate use of IC-1 "R" and IC-1 "Y", producing the RY tone sequences.

Position "0" allows a 22 ms opening to be inserted before each new character whether in RY or LTR mode and gives everything a chance to settle down. This makes up in part for the seventh (unit 7) Mark being only 22 ms wide.

Summation

Since the unit will probably be used into an AFSK unit, the filter shown in Fig. 6 should be used at the output of the tone generator to make the output into a pretty good sine wave. It is lifted exactly from an article by Bert Kelley K4EEU in July, 1973, *Ham Radio*, page 6. It worked so well on the SSTV adapter I built and mentioned earlier that I have sort of adopted it – hi! It passes the SSTV nicely, too, so you can use it even if you build the total combination unit SSTV/RTTY.

A couple of tips are in order if you are building an AFSK unit and are going to use this adapter to set things up. (1) Don't overdrive your filters; some type of compression limiting is highly desirable, coupled with an AGC system in your audio channel of the AFSK unit. (2) Consider a pair of active T filters in tandem as a front end. A switch selected resistor tunes each of them to the right high-pass and low-pass frequency easily. This tandem pair forms a bandpass circuit rejecting low frequency noise and high frequency chirps and peeps you tune across (and that tune across you). And finally, (3) DO try a trick I have learned from EME and Oscar listening that works gangbusters on RTTY for tuning. Do build the AFSK unit so that the incoming signal decoded into a dc shift in level keys your AFSK tone generator for sending – even when receiving. The keyboard controls it sending, and the incoming decoded dc shifts controls it on receive. This allows you to put a monitor and speaker/headphone jack on the AFSK sending unit's output. Obviously you can now monitor your sending for openers, but the best deal of all is receiving/tuning. Feed the output direct from the receiver speaker output to the AFSK receive input and the right or left earpiece of your headphones. Next feed the monitor output to the remaining earpiece of the headphones. Tuning becomes a snap – make the receiver sound like the monitor! Build the AFSK unit to have Mark-Hold in the absence of signals. As you tune in on a RTTY signal it will have one note (Mark) that sounds more and more like the other earpiece (monitor). As you tune closer yet, your decoder begins

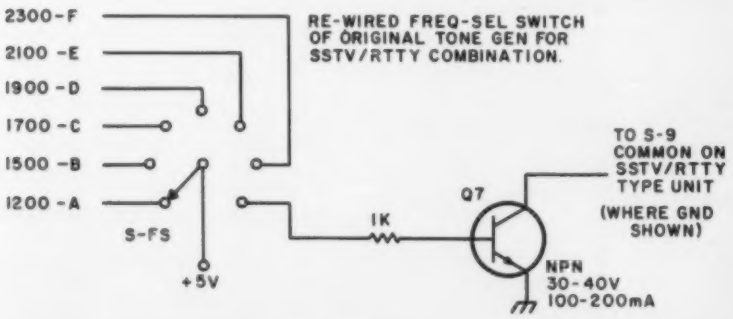

Fig. 4.

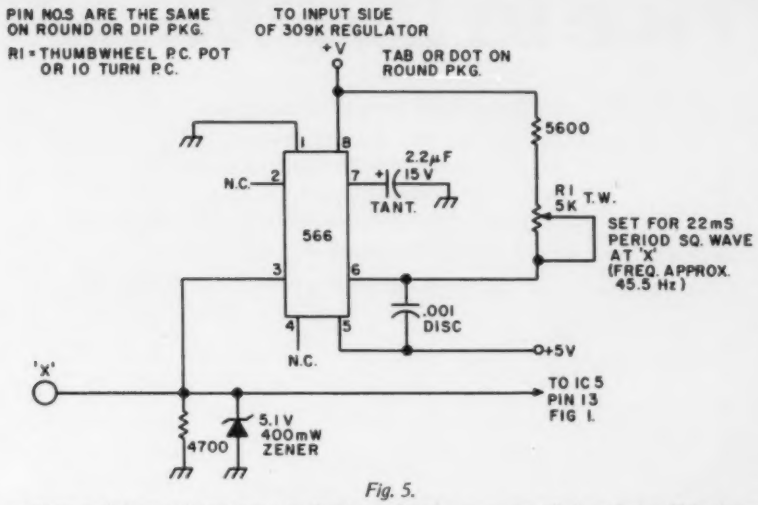

Fig. 5.

working and the machine comes to life since now it sees Mark-Space changes. Make the two sound alike and you are in the money.

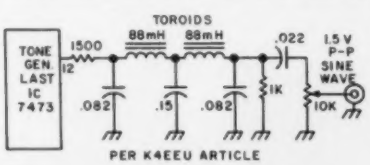

Fig. 6.

Sneaky way to tell in a hurry if he is on narrow shift and you on wide, etc., if either will key your decoder, but your AFSK sending unit is set up (switched) to the wrong shift – the Space tones never match – only the Mark tones!

Per usual, an SASE will bring whatever help I can be, but there should not be much trouble with this one with so few parts and wiring. For that reason, there is no circuit board layout. If enough guys want one, I guess I could lay one out for this and the SSTV unit. I built mine right into the RTTY rack mounted control unit. It also contains such things as a K2OAW CW identifier which was part of a repeater control by Pete. I just put a solid state timer or manual switch control into it, and it sends my call either every ten minutes if I send that long straight, or at the beginning of each transmission. I begin all transmissions with a blank key which sends nothing on my machine, but momentarily breaks the loop. Anytime the loop breaks, a PTT arrangement like VOX keys the transmitter, and the identifier identifies by shifting the Mark tone a small amount, but not enough for the other guy's unit to leave the Mark-Hold and print garble. This is quite legal and a widely used means of CW identifying. When it is running (10 wpm CW), the keyboard is disabled and the line over-run lamp on my Model 19 blinks in step with the CW being sent. Really quite easy, and sure makes RTTY a lot more fun than keeping one eye on a clock, your fourth hand keying the transmitter, etc. It is a collection of other guys' articles plus some original ideas all boiled into one small package by sharing parts, but I guess I should write it up if there is still interest enough in RTTY anymore – it sure works well.

Hope you enjoy the adapter, and a little careful wiring should have it working right the first time. TTL and digital things work that way – wire it right and it loves you. ■

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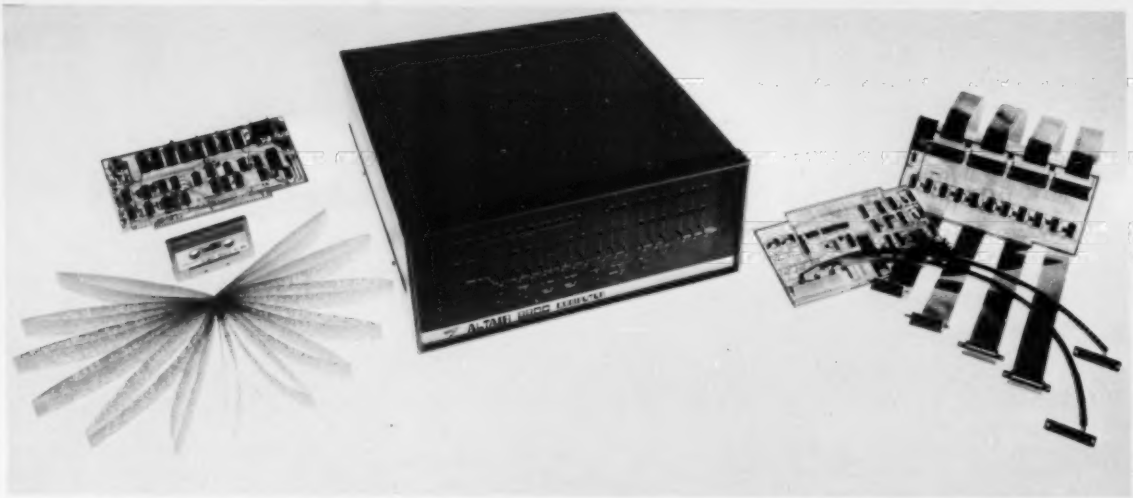

Computer. The Altair 8800 is the best-selling general-purpose computer in the world today. It is a parallel 8-bit word/16-bit address computer with an instruction cycle time of 2 microseconds. It was designed for almost unlimited peripheral and memory expansion, using a bus system where all input/output connections merge into a common line. The Altair 8800 is capable of addressing up to 65,536 words (bytes) of memory. *Regularly priced at $439 for a kit and $621 assembled.*

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by
Allan S. Joffe W3KBM
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What's That In Binary?

My first introduction to the world of computers left me with a reaction similar to the one I had when I saw my first schematic of a single sideband rig. The HHW* flag came up in every register.

I also tend to break out into a rash when real math comes my way, which is not the best reaction when starting to shake hands with computers.

Since others of the ham fraternity may suffer similar reactions, I have dredged the contents of my SVM** to recall a simple way of converting a base ten number into the binary numbering system or into the octal system of notation.

Interestingly enough, I was exposed to this method some thirty-five years ago, in, of all places, a Latin class. The instructor believed in making things come alive by spending some class time showing us how to multiply and divide Roman numerals. Computer stuff, by comparison, is mere child's play — and it is no wonder the barbarians wiped out Rome. It had to be painfully obvious that the Romans were so busy XXVIIing it that they had no time left to fight a mere war.

Here is a little something for my fellow non-math lovers:

$$A_{1b} + A_0 + \sum_{1}^{\infty} a^{-1} b^{-1} \ldots$$

It is perfectly obvious that this little bit of razzle-dazzle contains all the wisdom needed to convert a number of any base or radix to a number with any other base. For example, a decimal number to a binary number or an octal number to a decimal number.

Rather than trying to unscrew the unscrutable by translating this little gem into basic English, let me pass on a simple nuts and bolts nugget of wisdom derived from said mathematical mouthful.

Specifically, let's examine a way to convert any decimal number, such as 19758 or a number of your choice, to binary or octal. All you need is the native ability to divide by two or by eight.

Decimal to Binary Conversion

1. The digits as derived are set down right to left, the rightmost digit being the least significant bit and the leftmost digit being the most significant bit.

2. We divide the number first into odd or even by inspection. If the number is even we automatically make the least significant bit a ZERO. If the number is odd, we make the least significant bit a ONE.

3. Now we proceed to divide the number by two in a series of successive divisions. We ignore fractional remainders produced by the divisions, i.e., 19 divided by 2 would produce a real world answer of 9½, but we would ignore the remainder or fractional ½.

4. Any division that produces an EVEN number gives us a ZERO in our process of converting decimal to binary.

5. Any division that produces an ODD number gives us a ONE in our process of converting decimal to binary.

6. The process of successive divisions ends when the number is finally reduced to ONE again, ignoring any fractional remainders.

Example: Convert Decimal Number 38 to Binary

1. By inspection, since 38 is an even number the least significant bit is a ZERO.

.....0

2. 38 divided by 2 = 19. Nineteen is ODD, hence next bit is a ONE.

....10

3. 19 divided by 2 = 9 (ignore fraction). Nine is ODD, hence next bit is a ONE.

...110

4. 9 divided by 2 = 4 (ignore fraction). Since 4 is even, next bit is a ZERO.

..0110

5. 4 divided by 2 = 2. Since 2 is even, next bit is a ZERO.

.00110

6. 2 divided by 2 = 1 (divisions end). Since ONE is ODD, the next bit is a ONE.

100110

The final binary number thus produced is decimal 38 converted to its binary form.

This painless method makes it much easier to generate decimal to binary conversions than remembering the absolute values of each binary bit, particularly for conversions where the decimal number is four or five digits long.

Decimal to octal conversion is a similar process involving successive divisions by eight. However, the signposts in the divisions are different. In the decimal to binary conversion we completely ignored the fractional parts associated with the successive divisions. In the octal conversion we use the numerator of these fractional parts to tell us what the octal bit values are to be.

As you know, in binary or base two, we only have a string of ONEs or ZEROs in the final conversion. In octal or base eight we use the numbers ZERO through SEVEN.

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Decimal to Octal Conversion

1. As in the binary conversion, we are using a series of successive divisions; this time the constant divisor is 8. The same rule of bit value applies: Rightmost digit is the least significant bit and the leftmost digit is the most significant bit.

2. Select a number in decimal to be converted to octal and divide it by 8. This will result in a whole number or a whole number plus a fraction. If the result of the division is a whole number, the octal bit is a ZERO.

3. If the division results in a whole number plus a fraction then the octal bit is represented by the numerical value of the numerator of the fractional part.

4. The next successive divisions divide the whole number part of the previous division by 8, applying the above rule for determining the bit value of the octal number.

5. The successive divisions come to an end when you are left with a simple fraction.

Example: Convert Decimal 525 to Octal

1. 525 divided by 8 = 65-5/8. Thus our least significant bit is 5.

...5

2. 65 divided by 8 = 8-1/8 thus our next bit is 1.

..15

3. 8 divided by 8 = 1-0/8. Since ONE is a whole number the next bit is a ZERO. The form 1-0/8 is shown to make it clear that the numerator is really still our guidepost even in the case of "no" fractional remainder.

.015

4. We now divide ONE by 8 (which equals 1/8), which produces our most significant bit — and the division process ends as we are down to a simple fraction.

1015

Thus 525 decimal has been converted to 1015, which is its octal equivalent.

These simple conversions will make life a bit more livable when you meet the computer, and you are a giant step ahead of good old Flavius Maximus, who had to MCXVII it all the way to the Circus Maximus checkout. By the time he got his change counted, the show was over! ■

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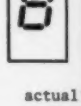

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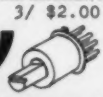

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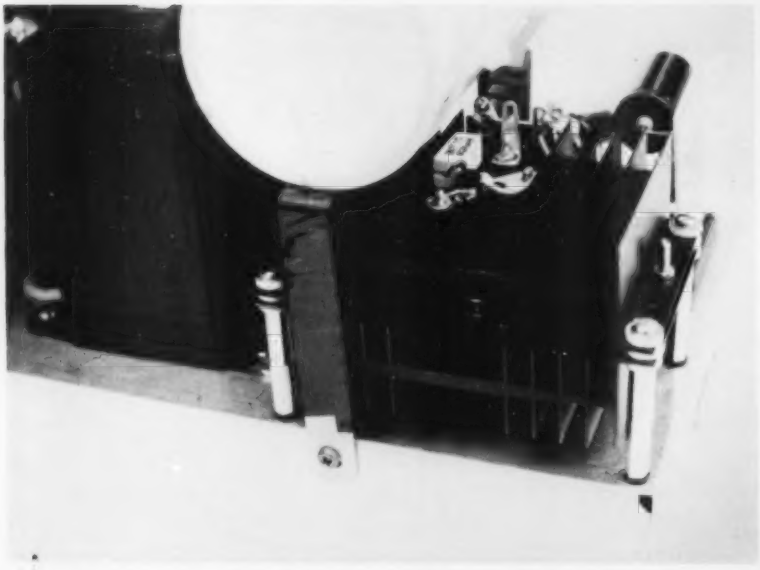
The Smart Power Supply

The need for a good, laboratory grade high current power supply prompted the design of this continuously variable current and voltage regulated supply for general bench use. Various parameters were considered with an eye to size, cost and simplicity. It was decided to design a 0-20 Amp, 0-25 volt regulated supply with an additional regulated 5 volt, 10 Amp logic output for experimenting with high current TTL circuits.

A Motorola chip MC1466 is available for $7.50 from most IC distributors. This basically is the heart of the power supply. The chip continuously monitors the voltage/current requirements and provides an output proportional to the various parameters as set by front panel controls. This output is fed to some pass transistors to boost the current to the required level. All the regulator parts are mounted on a PC card with the exception of the 2 pass transistors and their emitter resistors.



Heat sink and capacitor (C15) mounting. Unregulated voltage from the bridge rectifier assembly is attached to one of similar screws at each end of heat sinks. 2N3055 pass transistors are fastened to heat sinks. The .10 Ohm resistor in view was used in prototype, but higher current supply as described in text must have two each.

With this design, any voltage/current relationship may be employed, the output depending only on the maximum ratings of the 2 pass transistors and the transformer/rectifier used. It would not be unrealistic to use this same circuit but with a different transformer to provide a 0-50 volt, 30 Amp supply, or by changing both transformer and pass transistors a 0-500 volt, 2 Amp supply. The chip is quite versatile, maximum current and voltage output being determined by the value of the voltage and current adjust pots. For maximum output, 1 mA must flow through pins 3 and 8 of the IC. Therefore, for a 25 volt supply, this value is 25k. For a 50 volt supply, it is 50k. As long as the voltage from the rectifier is 2 volts or so above the maximum value required, the finished unit will exhibit voltage and current limiting to the required maximum limits.

The circuit is straightforward and simple. An auxiliary supply, 20 to 30 volts at 20 mA, is required for operation of the MC1466. A Calrad or similar Japanese transformer rated at 26.5 volts at 80 mA was used with a simple on-card half wave rectifier and filter capacitor. The main dc supply is obtained from a Signal Transformer Company 18-12 transformer. This transformer has two center-tapped windings rated 18 volts at 12 Amps. Paralleling these windings and utilizing a bridge rectifier gives a maximum 25 volt, 24 Amp output from the supply. Transient and noise protection to the IC is necessary and is accomplished by C_1, C_2, C_3, C_9, C_{10}, C_{11}, R_1 and D_3. The capacitors equalize high frequency components across the main and auxiliary supplies while the resistor and zener diode shunt transient spikes around the IC.

A range switch switches the transformer secondary taps to keep from wasting power. When up to 10 volts or so is needed, this switch controls a relay which is hooked to

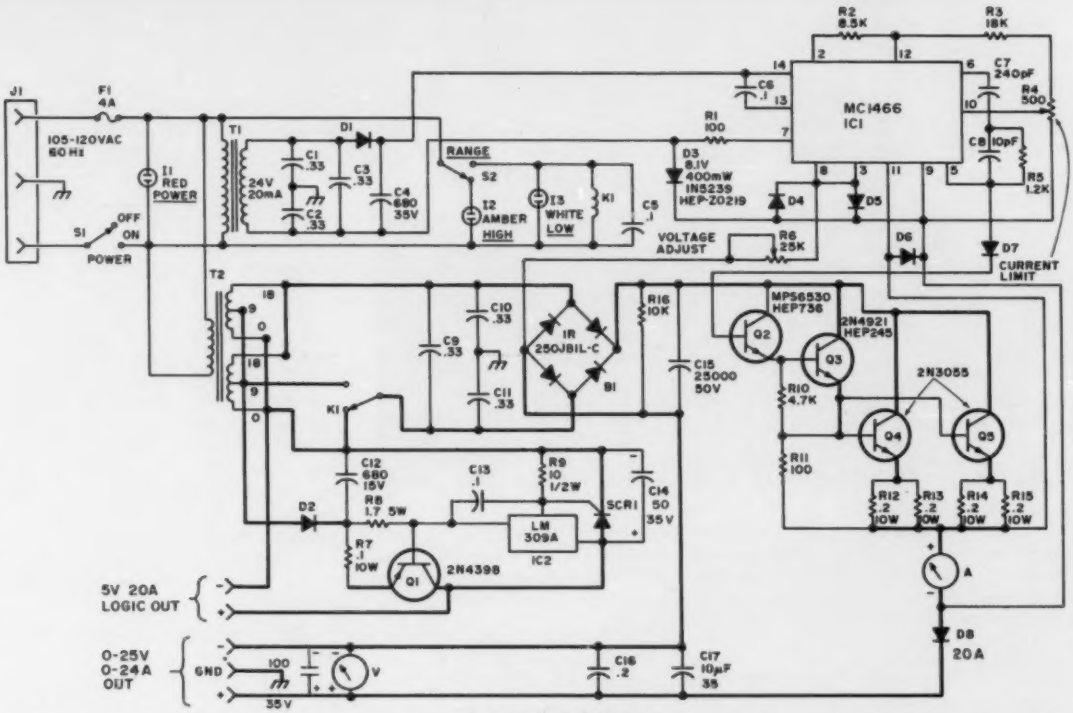


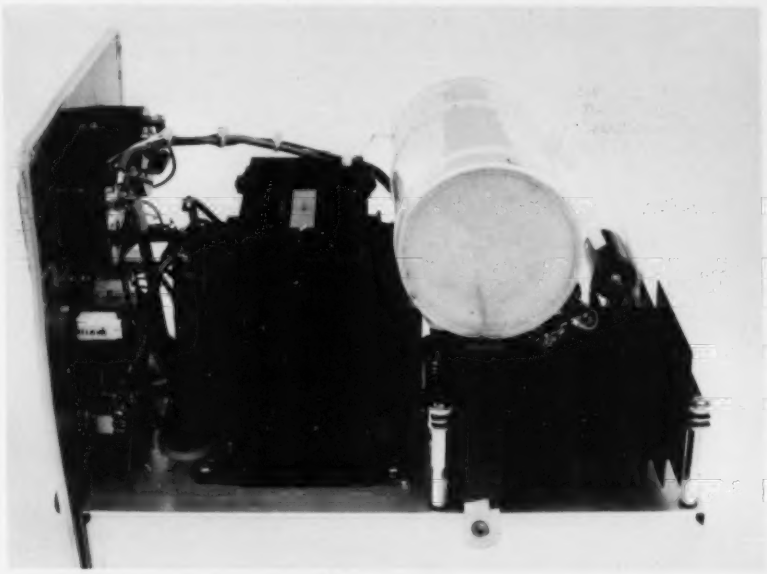
Fig. 1. Schematic. Note: All resistors ¼ Watt except where noted. All diodes 1N4002 or equivalent except D2, D3, D8. D2, D8 are 50 piv 20 A. Dark lines indicate #12-#14 wire or heavier. All other wiring #18.

the 0 and 9 volt taps on the transformer. If higher voltage is needed, it must be placed in the high position which utilizes the full secondary of the transformer.

Since cost was a factor, inexpensive Japanese meters were used. They are accurate to within 4% of full scale. With respect to voltage, this is a mere one volt. When checked against DVOM, they were found to be well within this accuracy.

The bridge rectifier used was an IR 250 JBIL-C, rated at 25 Amps, 100 piv. Since this is an integrated bridge rectifier configuration designed to be mounted on a single heat sink, it was used to save the space four discrete mount rectifiers would require. Note that an adequate heat sink is required (IR HE 510).

After filtering, the 25 volt output from the main supply is fed to the pass transistors and the regulator card. The pass transistors are two 2N3055s in parallel for current requirements mounted on two IR HE513 heat sinks. The collectors must be insulated from ground since they are connected directly to the unregulated dc output from the filter. The IR heat sinks have insulated mounting bushings which preclude the use of mica transistor insulators and thus provide better heat sink action. The four 0.2 Ohm resistors (R12-R15) equalize the emitter loads and allow for differences in



Side view of supply.

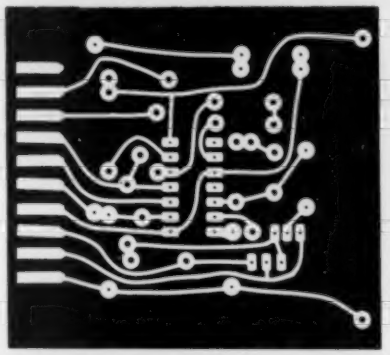
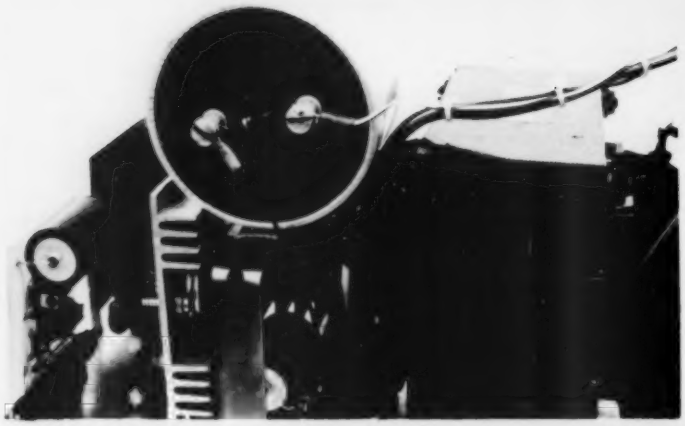


Fig. 2(a). PC board (full size). Etched, drilled and tin-plated boards are available from the author for $5.00 each. Send SASE.



Method of mounting capacitor C15 (25000 uF). Large cable ties strap it to heavy aluminum bar, bent to fit chassis. Heat sink to left contains 10 A 5 V logic regulators. Small capacitor beneath is C12; C13 is visible attached to LM309 socket. R16 is attached to C15 terminals.

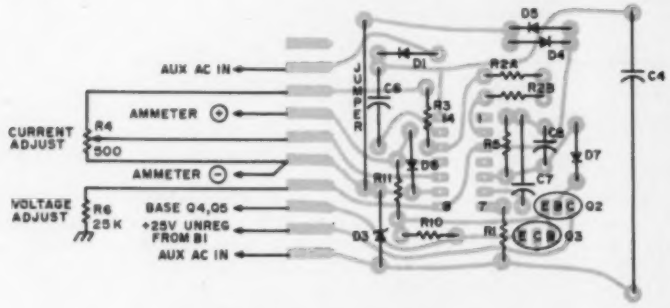
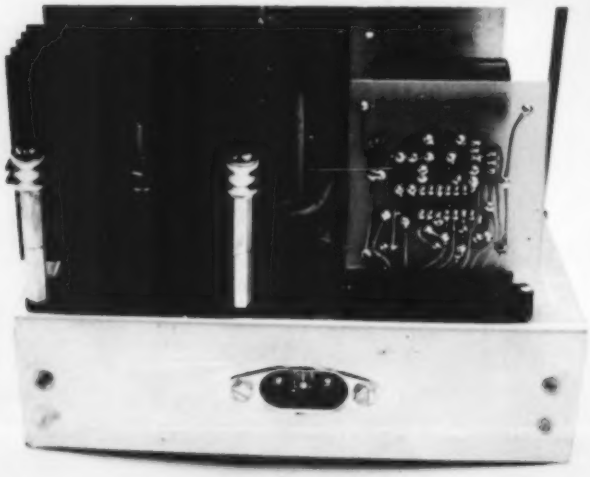


Fig. 2(b). Component layout.



Rear view of power supply showing PC board and heat sink mounting (for pass transistors). PC board contains all regulating parts except for pass transistors.

individual transistors. At full output, each parallel leg passes 10 Watts. Thus 2 resistors at .2 Ohms, 10 Watts in parallel are hooked to the emitter of each transistor to give a .1 Ohm, 20 Watt resistor. A terminal strip is fastened to the heat sink for the other end of these resistors by tapping out a 6-32 hole in the heat sink and mounting the terminal strip so that the resistors fit snugly along the channels of the heat sink.

This method helps keep the resistors cool and makes for a neater layout. After connecting these terminal strips together with heavy wire, another length of 12 or 14 gauge wire is run to the current meter. Note that if this meter is not used, a .025 Ohm, 15 Watt resistor must be used across diode D3 (or 4 0.1 Ohm, 5 Watt resistors). Also diodes D4, D5 and D7 must be used if your input voltage is above 20 volts, for protection of the chip during short circuit or transient conditions. Additional protection is insured by D6 in the case of simultaneous pass transistor failure and output short circuit, and D8 protects the power supply in circuits with a high ac content which could damage the IC.

The logic supply consists of an LM309 and 2N4398 (or equivalent) shunt transistor to provide a fixed 10 Amp, 5 volt regulated supply for logic designs where high current TTL is used. The 0 and 9 volt ac taps from the power transformer are used for primary input power. This is rectified in a simple half wave circuit and filtered with C12. C13 prevents oscillations from lead dress or other factors evident in some of these surplus 309s. The LM309 then provides the control and protection circuitry for the entire circuit. Current limiting is achieved by limiting the base drive to the PNP transistor under short circuit conditions. The internal current limit for the LM309 is approximately 3 Amps. Under short circuit conditions, this causes about a 3.4 volt drop across R8, one Amp being needed to drive the base of the transistor. Assuming a 1 volt VBE for the 2N4398, the peak output current is then limited to about 10 Amps. The transistor and LM309 are mounted on a common heat sink allowing the thermal limiting circuitry of the IC to protect both the power transistor and regulator in case of excessive dissipation. Additional protection is achieved by the SCR and R9. If the output rises above 5 volts, the internal zeners in the LM309's output conduct, greatly increasing the ground pin current. When the output approaches approximately 7.5 volts, the SCR will fire, thereby shutting off the over-voltage and protecting the circuit under test. Under normal conditions, only about 50 mV is dropped across R13. Since the 50 Amp SCR is expensive, this is not a necessary addition. If this is omitted, however, the 10 Ohm resistor R13 should be shorted. This crowbar circuit is effective and is good over voltage protection, however, since the 5 volt supply is not metered.

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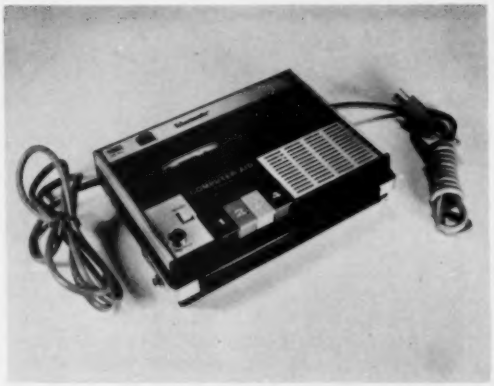

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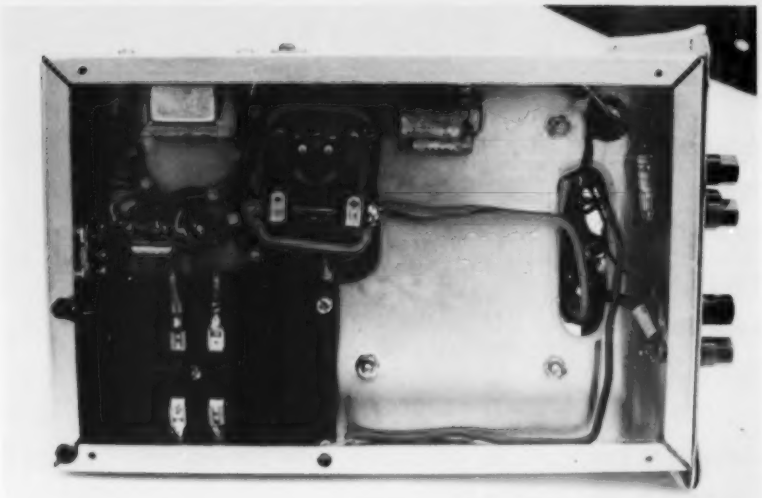


Bottom view of chassis, showing PC board socket wiring, relay placement, and rectifier and heat sink location.

The whole circuit is built into a Bud WA1541 portacab on a Bud AC407 chassis. This cabinet has a handle on the top for easy carrying and is usually found at hamfests, sans front panel which can be easily made. The front panel layout is included in Fig. 3 for photo layout on Scotchcal® or other panel materials. The 2N3055 transistors are mounted on heat sinks which are placed bottom to bottom so that the mounting flanges are closest to each other. After the 2N3055s are mounted and R12-R15 installed as previously stated, a hole is drilled through the center of each heat sink flange and a 6-32 screw with a 6-32 nut, used as a spacer, on each holds the heat sinks together. The main supply connects to one of these screws. The insulated bushings supplied with the heat sinks are secured in place and the whole assembly is mounted on the right rear corner of the chassis using threaded spacers. Directly underneath these heat sinks on the inside of the chassis, the heat sink for the 25 Amp bridge rectifier is secured through the chassis to the threaded spacers. A hole is drilled and tapped in the bridge heat sink to accept an 8-32 screw, which secures the rectifier assembly. The use of silicone grease is recommended to insure adequate heat sinking. Since the IR 250 JBIL-C rectifier is insulated from ground, no mica insulators are needed.

The PC card is designed for a Cinch 50-10A-20 board edge connector. This connector is fastened through the left rear of the chassis and wired. Directly in front of this is another heat sink for the LM309 and 2N4398. The front half of the chassis is reserved for the main power transformer T2. Underneath, the auxiliary supply transformer T1 and relay K1 are located. Filter capacitor C15 is a 25000 microfarad 50 volt unit obtained surplus. It is so large physically that it had to be mounted to a piece of steel bracket bar ½" wide, which was bent to go up, over and down past the pass transistors and other heat sinks on the top. It is then fastened to the chassis sides and the capacitor held in place with large wire ties. The photos show the layout of the larger parts.

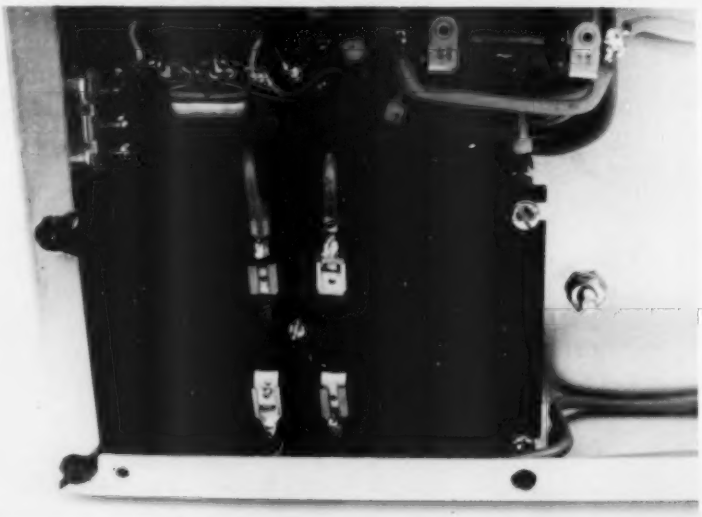
Substitutions are no problem. The pass transistors can be any high current types. The others can be any substitutes, keeping in mind that an F_t of $>$ .5 MHz is desirable. The diodes, except for D2 and D8, are all 1N4002 or any 1 Amp garden variety plastic diodes. If the space is available, the IR bridge assembly may be converted to 4 discrete diodes wired in a bridge configuration but with adequate heat sinks. D2 and D8 are 20 Amp diodes heat sinked to the chassis. The main transformer, as stated previously, can be any voltage desired, not to exceed the Vce ratings of the pass transistors. Similarly, the current ratings can be 2 Amps or 200 Amps, making sure, again, that your chosen pass transistors will handle it. Relay K1 is a surplus 110 volt DPDT unit with 15 Amp contacts wired in parallel.

After construction, check the unit out by placing it on its side and setting the controls as follows:

Voltage Adjust	Fully ccw
Current Adjust	Nine o'clock
Range Switch	Low

Turn the unit on and make sure the "low" and "power" lights come on. Set the range switch to high and check its indicator. Then rotate the voltage control until the voltage meter reads 10 volts. Rotating the current limit pot fully ccw, the voltage will fall to zero. Next connect the 0-25 volt terminals together and carefully adjust the current limit pot until the current meter reads 2 Amps. Let this condition remain for a few moments to check for signs of overheating. Next, a 10 Ohm, 10 Watt resistor should be placed across the output which will indicate a current of one Amp. Watch the voltage meter for signs of fluctuation while hooking this up to check the regulating circuits. A small drop may be evident which will be as a result of I^2R losses in the wiring and current meter.

Do these steps in exactly the above manner if you are not sure what you are doing. If all seems normal, disconnect the load and rotate both voltage and current adjust pots to max and watch the meters. Throw the range switch to low and assure that the voltage drifts to about 12 volts with no load.



Close-up of 250JBIL rectifier bridge and heat sink assembly, showing method of mounting and wiring.

If all seems normal, install in the cabinet using the 4 panel mounting screws. Next, place it on the rear end and drill out the chassis flanges to accept #8 self-tapping screws, and affix rubber feet through the cabinet to these holes. Do not rely on the 4 panel screws because of the weight of the transformer.

The prototype has been in use for the last three months and has been found to be reliable and trouble free. The power supply exhibits a low impedance at all frequencies and low noise. It has been used at full output to service a 100 Watt Class C amplifier being driven by a 10 Watt transceiver, as well as a low current automobile tape deck, and performed equally as well on both set ups. It was a pleasure to set the voltage output to 13.5 volts, key the transmitter and amplifier and watch the output remain constant in spite of the increased current, a fact not before possible when unregulated, variac controlled power supplies were used. Charging batteries is another use to which this has been put. A constant charge rate is easy to achieve by setting the voltage to anything over what the battery is rated and setting the current flow to the desired rate. ■

References

Motorola Applications Note DS 9130 R3.

Electronic Engineering Times, "IC Regulators Boost Protection."

"Regulated, Variable Solid State High Voltage Power Supply," *Ham Radio*, January, 1975, p. 40.

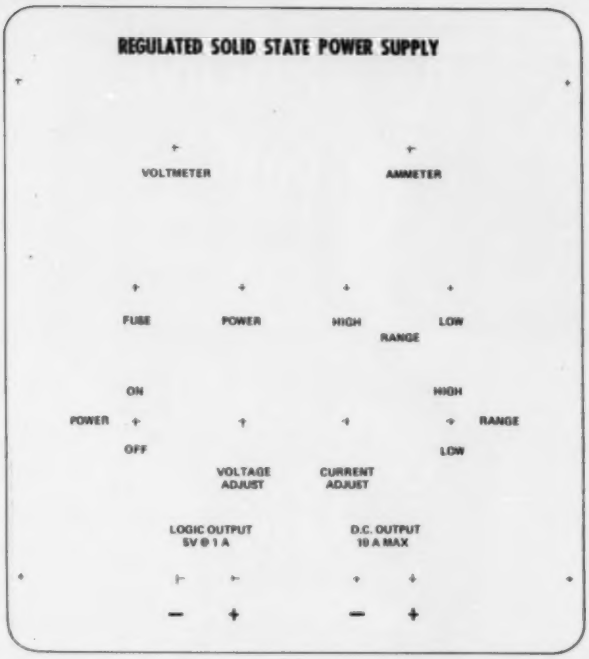


Fig. 3. Front panel layout for photo sensitive panel (50%). Black letters on brushed aluminum Scotchcal® with stick-on back are available from the author for $5.00 each. Send large (8½" x 11") SASE.

FOR YOUR EYES ONLY

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MC14412 contains a complete FSK modulator and de-modulator compatible with foreign and USA communications. (0 – 600 BPS)

FEATURES:

- On chip crystal oscillator
- Echo suppressor disable tone generator
- Originate and answer modes
- Simplex, half-duplex, and full duplex operation
- On chip Sine Wave
- Modem self test mode
- Selectable data rates: 0 – 200, 0 – 300, 0 – 600
- Single supply
  VDD = 4.75 to 15 V DC-FL suffix
  VDD = 4.75 to 6 V DC-VL suffix

TYPICAL APPLICATIONS:

- Stand alone – low speed modems
- Built-in low speed modems
- Remote terminals, accoustical couplers

MC 14412 FL 28.99
MC 14412 VL 21.74
6 pages of data ..... .60

MC14411 Bit Rate Generator. Single chip for generating selectable frequencies for equipment in data communications such as TTY, printers, CRTs or microprocessors. Generates 14 different standard bit rates which are multiplied under external control to 1X, 8X, 16X or 64X initial value. Built-in crystal oscillator circuit. Operates from single +5V supply.
MC14411P with specs $22.40

Output Rates (Hz)			
X64	X16	X8	X1
614.4 k	153.6 k	76.8 k	9600
460.8 k	115.2 k	57.6 k	7200
307.2 k	76.8 k	38.4 k	4800
230.4 k	57.6 k	28.8 k	3600
153.6 k	38.4 k	19.2 k	2400
115.2 k	28.8 k	14.4 k	1800
76.8 k	19.2 k	9600	1200
38.4 k	9600	4800	600
19.2 k	4800	2400	300
12.8 k	3200	1600	200
9600	2400	1200	150
8613.2	2153.3	1076.6	134.5
7035.5	1758.8	879.4	109.9
4800	1200	600	75
921.6 k	921.6 k	921.6 k	921.6 k
1.843M	1.843M	1.843M	1.843M

12 BIT CMOS MICRO CPU. IM6100 is a silicon gate CMOS, fully static, single address, fixed word length, parallel transfer microprocessor using 12-bit 2's complement arithmetic. This processor recognized the instruction set of DEC PDP8/E. The internal circuitry is completely static and will operate from DC to 4 MHz clock rate. Has on chip oscillator and clock or can be driven externally.
Operates from single +5V supply at less than 10mW. TTL compatible. Design is optimized to minimize the number of external components required for interfacing with standard memory and peripheral devices.

- Executes PDP8/E instructions
- Direct, indirect, auto index memory address
- 12 bit add = 5 microseconds
- I/O instructions = 8.5 microseconds
- Single clock, single instructions capability
- DMA
- Interrupt
- Dedicated control panel

Has all CMOS support for low power. Entire system could be battery operated!
IM6100 ..... $65.00
Manual 4.00

MC14410 CMOS Tone Generator produces Standard Dual Frequency Telephone Dialing Signal. (Directly Compatible with our 12 Key Chomeric Pad.)
MC14410 ..... $9.28
4 Pages of Data ..... .40¢

LM3909. Monolithic IC designed specifically to flash LEDs from 1.5V battery supplies. Requires only battery and 1 external cap.
LM-3909 ..... $1.17. specs ... 50¢

LM3911 Temperature Controller Chip. Highly accurate temperature measurement or control system. Single monolithic chip contains sensor, stable voltage reference and op amp. 8 pin DIP. LM3911N $1.59
8 pages of specs and apps ..... .80¢

5V, 5A TO-3 Regulator. Fairchild 78H05 hybrid regulator in TO-3 power package. Use it with the same ease of installation as the famous 309K (same pin arrangement). Take care of those heavy current requirements without separate regulator/pass transistor combinations.
78H05 .. 5V, 5A $10.95
3 pages of specs ..... .30¢

1 AMP Adjustable Regulators. 78GKC (positive) and 79GKC (negative) are 1 amp adjustable voltage regulators, programmed by only 2 external resistors. Can be implimented into ± tracking regulators with only 3 external resistors. Thermally protected, short circuit current protected. Use the same regulator for all your fixed voltage requirements. Don't stock assorted regulators – stock assorted resistors!
78GKC .. (+5 to +30V) $2.75
79GKC .. (-2.25 to -30V) $3.50
8 pages of specs .. 80¢

T0-92 VOLTAGE REGULATORS. If your project needs only 100 mA or less, use these tiny plastic regulators right on your PC board. Last 2 digits denote voltage (positive).
LM78L05, LM78L12, LM78L15 ..... .85¢

8220 MEMORY. 8 bit (4X2) content addressable memory. TTL and DTL compatible. For use in data-to-memory comparison, pattern recognition, cache memory, auto correlation, virtual memory, learning memory. New, house numbered. With data. 16 pin DIP.
CAM-8220 ..... .50¢, 10/$3.50

F95H90. 250 MHz ECL prescaler divides by 10 or 11. Upgrade your present counter.
w/spec $10.50

F11C90. 650 MHz ECL prescaler divides by 10 or 11. TTL compatible.
11C90 .. w/spec $19.95

3 AMP, 100V DIODE. Brand new epoxy cased with heavy leads. Type NS3001.
TAR-3001 ... 15¢, 10/$1, 100/$8

Super Small Slide Switch. About as small as we've seen, it's only .2" X .4" long. Mounts on PC board. SPDT. Leads spaced .15".
SSS-0102P 10/1.75

COS/MOS DIVIDE-BY "N" COUNTER. RCA CD4059 is a synchronous programmable divide by "N" counter with "N" any number 3 to 15,999. TTL drive capability. 24 pin package.
CA4059 ..... $6.50
6 pages of specs ..... .60¢

MINIATURE DIP SWITCHES

Miniature rocker type DIP switch arrays for PC mounting. Fit standard DIP sockets. Comes in contact arrangements 4 to 10 per pack. The last 2 digits of the part number indicate number of switches per pack.
DIS-76B04 .. $3.10 DIS-76B08 .. $3.95
DIS-76B06 .. $3.50 DIS-76B09 .. $4.15
DIS-76B07 .. $3.75 DIS-76B10 .. $4.35

Miniature ¼" Toggle Switch. SPDT 5A, 125V. C&K type 7101 with bushing mount or horizontal right angle PC mounting.
MTS-7101H ..... .95¢

7V, 1 Amp midget transformer. Open frame transformer with solder lug terminals. Ideal source for 5V supply
LVT-0701 ..... $1.49

Reed Relay. 3PST N.O. reed relay. Quality made by Wheelock. 12VDC coil. PC mount. Only 1.4" x .6" x .4"
RRY-0301-T $1.50

12VDC, 16 AMP Relay. For mobile, aircraft and bench systems using 12V DC. SP, NO contacts. Best relay buy in the country for mobile radio applications.
RYH-1216 ..... $1.00

1 MHZ CRYSTAL. Especially made for new touch tone encoder chip. In HC-6 case
XTL-0106 ..... $4.95

LED MOUNTING HARDWARE

Molded socket block accepts standard 7 segment LED readouts with .3" row spacing. Pins are .65" long wire wrap type. Bezel and socket block are black molded plastic with viewing screen available in red, amber or smoky neutral, circularly polarized for glare reductions. Unique mounting system is self fastening to panel cutout. Two sizes available. 1750 series for use with up to .4" high readouts.
1750-04 (4 readout) $7.00
1751-04 (4 readout) $7.27
1750-06 (6 readout) $9.00
1751-06 (6 readout) $9.31
1750-08 (8 readout) $11.00
1751-08 (8 readout) $11.34
(Specify red, amber or neutral screen color)

TOUCH TONE PADS

12 key pads for interface to T.T. generators. Black bezel with dark grey escutcheon, white lettering. Has standard 2 circuit to common matrix. In addition to numerals, it has standard phone alphabetic characters plus "operator." 2.25" x 3.0". 8 pin staggered contact columns. Made by CHOMERICS.
TTP-0112 ..... $5.95
MC14410 Tone Generator 9.28
1 MHz C6 Xtal for T.T. 4.95

COPPER CLAD PHENOLIC BOARD. Beautiful 5-1/2" x 8" x 1/16" single side copper clad. All new, rag base.
CCB-5508 ..... 75¢, 10/$5

MK-20 TO-3 Mounting Kit. Anodized aluminum insulator.
MK-20 ..... 10/$2.99

RCA Photo electric system. CA3062 contains photo detector, amp and power driver. Can drive relays and triacs directly. Adjustable gain. Visible or infra-red operation. TO-5 can. May be used in linear mode.
CA-3062 ... $4.95, Specs 40¢

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7402	.15	7460	.17	74157	.99
7403	.16	7464	.35	74158	1.79
7404	.19	7465	.35	74160	1.39
7405	.19	7470	.30	74161	1.25
7406	.35	7472	.30	74162	1.49
7407	.35	7473	.35	74163	1.39
7408	.18	7474	.35	74164	1.59
7409	.19	7475	.57	74165	1.59
7410	.16	7476	.39	74166	1.49
7411	.25	7483	.79	74170	2.30
7413	.55	7485	1.10	74173	1.49
7416	.35	7486	.40	74174	1.62
7417	.35	7489	2.48	74175	1.39
7420	.16	7490	.59	74176	.89
7422	.26	7491	.97	74177	.84
7423	.29	7492	.71	74180	.90
7425	.27	7493	.60	74181	2.98
7426	.26	7494	.94	74182	.79
7427	.29	7495	.79	74184	2.29
7430	.20	7496	.79	74185	2.29
7432	.23	74100	1.30	74187	5.95
7437	.35	74105	.44	74190	1.35
7438	.35	74107	.40	74191	1.35
7440	.17	74121	.42	74192	1.25
7441	.98	74122	.45	74193	1.19
7442	.77	74123	.85	74194	1.25
7443	.87	74125	.54	74195	.89
7444	.87	74126	.63	74196	1.25
7445	.89	74141	1.04	74197	.89
7446	.93	74145	1.04	74198	1.79
7447	.89	74150	.97	74199	1.79
7448	1.04	74151	.79	74200	5.90
7450	.17	74153	.99		

LOW POWER TTL

74L00	$ .25	74L51	$ .29	74L98	$1.49
74L02	.25	74L55	.33	74L91	1.45
74L03	.25	74L71	.25	74L93	1.69
74L04	.25	74L72	.39	74L95	1.69
74L06	.35	74L73	.49	74L98	2.79
74L10	.25	74L74	.49	74L164	2.79
74L20	.33	74L78	.79	74L165	2.79
74L30	.33	74L85	1.25		
74L42	1.49	74L86	.69		

HIGH SPEED TTL

74H00	$ .25	74H21	$ .25	74H55	$ .25
74H01	.25	74H22	.25	74H60	.25
74H04	.25	74H30	.25	74H61	.25
74H08	.25	74H40	.25	74H62	.25
74H10	.25	74H50	.25	74H72	.39
74H11	.25	74H52	.25	74H74	.39
74H20	.25	74H53	.25	74H76	.49

8000 SERIES

8091	$ .53	8214	$1.49	8811	$ .59
8092	.53	8220	1.49	8812	.89
8095	1.25	8230	2.19	8822	2.19
8121	.80	8520	1.16	8830	2.19
8123	1.43	8551	1.39	8831	2.19
8130	1.97	8552	2.19	8836	.25
8200	2.33	8554	2.19	8880	1.19
8210	2.79	8810	.69	8263	5.79
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4001A	.25	4020A	1.49	4068A	.44
4002A	.25	4021A	1.39	4069A	.44
4006A	1.35	4022A	1.10	4071A	.26
4007A	.26	4023A	.25	4072A	.35
4008A	1.79	4024A	.89	4073A	.39
4009A	.57	4025A	.35	4075A	.39
4010A	.54	4027A	.59	4078A	.39
4011A	.29	4028A	.98	4081A	.26
4012A	.25	4030A	.44	4082A	.35
4013A	.45	4035A	1.27	4538A	1.60
4014A	1.49	4042A	1.47	4585A	2.10
4015A	1.49	4049A	.39		
74C00	$ .32	74C74	$1.04	74C162	$2.93
74C02	.26	74C76	1.34	74C163	2.66
74C04	.44	74C107	1.13	74C164	2.66
74C08	.68	74C151	2.61	74C173	2.61
74C10	.35	74C154	3.15	74C195	2.66
74C20	.35	74C157	1.76	80C95	1.35
74C42	1.61	74C160	2.48	80C97	1.13
74C73	1.04	74C161	2.93		

MARCH SPECIALS

½ PRICE SALE

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7430	.10	7475	.28	74123	.42
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7442	.38	7490	.29	74153	.49
7446	.46	7495	.39	74180	.45
7447	.44	7496	.39	74193	.60
7448	.52	74107	.20		

MARKED — NO FACTORY LOGO GUARANTEED FUNCTIONAL

7400	$.07	7420	.08	7460	.08
7402	.07	7437	.17	7474	.17
7403	.08	7440	.08	7493	.38
7404	.09	7445	.44	7496	.39
7406	.17	7450	.08	74195	.44
7408	.09	7453	.08		
7410	.08	7454	.08		

ALARM CLOCK CHIP
MM5375AA 4-6 digit, 12 hour, 60Hz snooze alarm, brightness control capability, alarm tone output 24 pin DIP ... **$4.95**

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Voltage controlled oscillator — sine, square, triangular output. 16 pin DIP with data **$3.95**

7001 CLOCK CHIP
4-6 digit, 12-24 hr. alarm, timer and date circuits — with data **$6.95**

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MM5330 — P channel device provides all logic for 4½ digit volt meter. 16 pin DIP with data **$14.95**

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5 function plus constant — addressable memory with individual recall — 8 digit display plus overflow — battery saver — uses standard or rechargeable batteries — all necessary parts in ready to assemble form — instructions included.
Kit with AC adaptor included **$14.95**
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Silver plated copper circuit board 3-3/16" x 5-1/16". 2 rows of 27 holes for DIP IC's • space for transistors, resistors & capacitors. Versatile and simple for breadboarding IC circuitry **$1.50 ea.**
50 pcs. **1.00 ea.**

ALARM CLOCK KIT
4 Large Digits • AM-PM. Complete kit includes TMS 3834 chip — green flourescent panel with .5" digits — PC board — alarm speaker — all necessary components — case — schematic and instructions.
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74S03	.38
74S04	.45
74S08	.52
74S10	.38
74S20	.38
74S22	.38
74S32	.52
74S74	.38

LOW POWER SCHOTTKY

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74LS02	.36
74LS04	.36
74LS08	.38
74LS10	.36
74LS20	.36
74LS32	.38
74LS40	.45
74LS42	1.48
74LS74	.59
74LS90	1.38
74LS93	1.38
74LS95	2.09
74LS107	.59
74LS164	2.38
74LS193	2.58
74LS197	2.28

LINEARS

546	AM radio receiver subst. DIP	$ .75
733	DIH. video AMPL TO-5	.89
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7525	Dual core mem. sense AMPL DIP	.98
MC1310	FM stereo demodulator DIP	1.95
CA3046	Transistor array 14 pin DIP	.89

6 DIGIT LED CLOCK KIT
INCLUDES:
MM314 clock circuit
6 FND70 LED displays (.250" red 7 segment)
All necessary transistors, resistors & capacitors
1 double sided PC board accommodates LED's & clock circuitry
Schematic & instructions
Does not include 12V-300 ma transformer, switches & case **$12.95**

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.1 mfd	35V	.25 ea.	6.8 mfd	6V	.38 ea.
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1 mfd	35V	.25 ea.	10 mfd	25V	.40 ea.
2.2 mfd	20V	.25 ea.	15 mfd	10V	.40 ea.
2.2 mfd	35V	.30 ea.	33 mfd	10V	.40 ea.
4.7 mfd	16V	.38 ea.	47 mfd	6V	.40 ea.

MISC. DEVICES

2513	64 x 8 x 5 character generator	$11.80
2602	1024-bit static RAM, N-channel DTL/TTL compatible	3.95
FR3410	256 bit RAM	2.19
MV5020	Jumbo green	.22
XC209-R	.125" red LED	.15
L100	Red LED	.15
L101	Red LED	.15

LED's

MV10B	Red TO 18	$ .22
MV50	Axial leads	.18
MV5020	Jumbo Vis. Red (Red Dome)	.22
	Jumbo Vis. Red (Clear Dome)	.22
ME4	Infra red diff. dome	.54
MAN1	Red 7 seg. .270"	2.19
MAN2	Red alpha num .32"	4.39
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MAN7	Red 7 seg. .270"	1.19
MAN3	Red 7 seg. .127" straight pins	.29
MAN8	Yellow 7 seg. .270"	3.45
MAN66	.6" high spaced seg.	3.75
MCT2	Opto-iso transistor	.61

MEMORIES

1101	256 bit RAM MOS	$ 1.58
1103	1024 bit RAM MOS	3.95
1702A	2048 bit static PROM UV eras.	17.95
2102-2	1024 bit static RAM	4.25
5203	2048 bit UV eras PROM	17.95
5260	1024 bit RAM	2.49
5261	1024 bit RAM	2.69
5262	2048 bit RAM	5.95
7489	64 bit ROM TTL	2.48
8223	Programmable ROM	3.69
74200	256 bit RAM tri-state	5.90

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NSN33	3 digit .12" red led 12 pin fits IC skt.	$1.79
HP5082 7405	5 digit .11 led magn. lens com. cath	3.49
HP5082 7414	4 digit .11 LED magn. lens comm. cath.	3.25
FNA37	9 digit 7 seg led RH dec clr. magn. lens	4.95
SP-425-09	9 digit .25" neon direct interface with MOS/LSI, 180 VDC, 7 seg.	1.79

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5001	12 DIG 4 funct fix dec	$2.49
5002	Same as 5001 exc btry power	2.79
5005	12 DIG 4 fuct w/mem	2.99
MM5725	8 DIG 4 funct chain & dec	1.98
MM5736	18 pin 6 DIG 4 funct	4.45
MM5738	8 DIG 5 funct K & mem	5.35
MM5739	9 DIG 4 funct (btry ocr)	5.35
MM5311	28 pin BCD 6 dig mux	4.45
MM5312	24 pin 1 pps BCD 4 dig mux	3.95
MM5313	28 pin 1 pps BCD 6 dig mux	4.45
MM5314	24 pin 6 dig mux	4.45
MM5316	40 pin alarm 4 dig	5.39

SHIFT REGISTERS

MM5013	1024 bit accum. dynamic mDIP	$1.75
MM5016	500/512 bit dynamic mDIP	1.59
SLS-4025	QUAD 25 bit	1.29

DTL

930	$ .15	937	.15	949	.15
932	.15	944	.15	962	.15
936	.15	946	.15	963	.15

Data sheets on request. With order add $.30 for items less than $1.00 ea.

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300	Pos V Reg (super 723) TO-5	$ .71
301	Hi Perf Op Amp mDIP TO-5	.29
302	Volt follower TO-5	.53
304	Neg V Reg TO-5	.80
305	Pos V Reg TO-5	.71
307	Op AMP (super 741) mDIP TO-5	.26
308	Micro Pwr Op Amp mDIP TO-5	.89
309K	5V 1A regulator TO-3	1.35
310	V Follower Op Amp mDIP	1.07
311	Hi perf V Comp mDIP TO-5	.95
319	Hi Speed Dual Comp DIP	1.13
320T	Neg Reg 5, 12, 15, TO-3	$1.39
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322	Precision Timer DIP	1.70
324	Quad Op Amp DIP	1.52
339	Quad Comparator DIP	1.58
340K	Pos V reg (5V, 6V, 8V, 12V, 15V, 18V, 24V) TO-3	1.69
340T	Pos V reg (5V, 6V, 8V, 12V, 15V, 18V, 24V) TO-220	1.49
372	AF-IF Strip detector DIP	2.93
373	AM/FM/SSB Strip DIP	.53
376	Pos V Reg mDIP	2.42
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380	2w Audio Amp DIP	1.13
380-8	.6w Audio Amp mDIP	1.52
381	Lo Noise Dual preamp DIP	1.52
382	Lo Noise Dual preamp DIP	.71
550	Prec V Reg DIP	.89
555	Timer mDIP	.89
556A	Dual 555 Timer DIP	1.49
560	Phase Locked Loop DIP	2.48
562	Phase Locked Loop DIP	2.48
565	Phase Locked Loop DIP TO-5	2.38
566	Function Gen mDIP TO-5	2.25
567	Tone Decoder mDIP	2.66
709	Operational AMP TO-5 or DIP	.26
710	Hi Speed Volt Comp DIP	.35
711	Dual Difference Compar DIP	.26
723	V Reg DIP	.62
739	Dual Hi Perf Op Amp DIP	1.07
741	Comp Op Amp mDIP TO-5	.32
747	741 Dual Op Amp DIP or TO-5	.71
748	Freq Adj 741 mDIP	.35
1304	FM Mulpx Stereo Demod DIP	1.87
1307	FM4 Mulpx Stereo Demod DIP	.74
1458	Dual Comp Op Amp mDIP	.62
1889	Stereo multiplexer DIP	2.48
LH2111	Dual LM 211 V Comp DIP	1.70
3900	Quad Amplifier DIP	.35
7524	Core Mem Sense AMPL DIP	.71
8038	Voltage contr. osc. DIP	4.25
8864	9 DIG Led Cath Drvr DIP	2.25
75150	Dual Line Driver DIP	1.75
75451	Dual Perepheral Driver mDIP	.35
75452	Dual Peripheral Driver mDIP	.35
75453	(351) Dual Periph Driver mDIP	.35
75491	Quad Seg Driver for LED DIP	.71
75492	Hex Digit driver DIP	.80

Satisfaction guaranteed. Shipment will be made via first class mail in U.S., Canada and Mexico within 5 days from receipt of order. Add $.50 to cover shipping and handling for orders under $25.00. Minimum order $5.00. California residents add sales tax.

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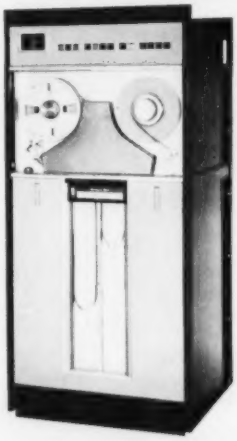
Computer BONANZA!

Card Reader



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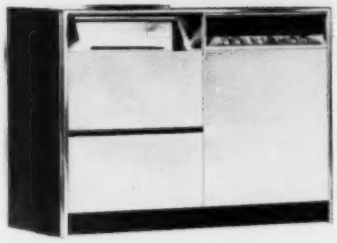

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Adrift Over Your C's?

by
F. G. Rayer G3OGR
Reddings, Longdon Heath
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WR8 ORJ, England

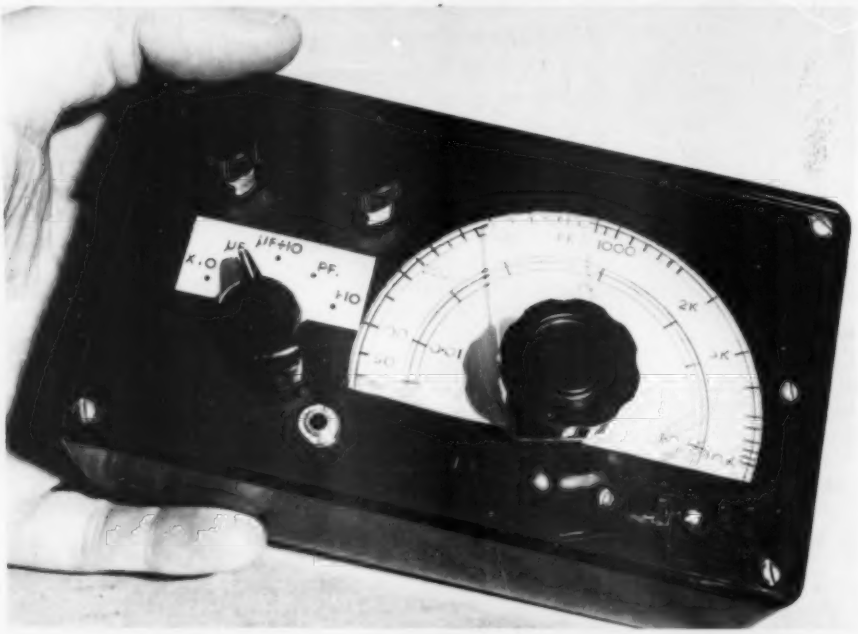
Once upon a time capacitors were nicely marked 0.1 uF, or even 0.05 MFD, or so on, as the case might be. But now it is necessary to deduce their value from a rainbow of bands or spots, not to mention such numberings as 4k7, 5n, 5pj. Is that last colored band a figure in the value, or a tolerance? Not to mention the useful collection of mica and other capacitors with obliterated markings, and those with only a maker's number. Having recently used some quite large tubular capacitors marked 5kp, in the expectation that they were 5,000 pF, or 0.005 uF, only to find they were in fact 50 pF, I decided it was high time a simple means of checking the values of doubtful capacitors was made.

The circuit of the result is shown in Fig. 1, and despite its simplicity it works nicely for values from 25 pF to 10 uF. Q1 and Q2 are combined to form an audio oscillator, output from Q1 being applied across the bridge.

The bridge has five capacitors, for five ranges. Cx is the unknown capacitor. VR1 is a linear pot (it must be linear) for balancing, and high resistance phones indicate the null, so that the capacitor value can be read from the setting of VR1.

Oscillator

Assembly details will probably not matter much, but the audio oscillator can be wired on a tag strip, as seen in the photo. Both the



transistors are audio or small output types, such as are available in great number, and it is difficult to find two transistors which will not work here. Q1 must, however, be NPN, while Q2 is a PNP type.

A quite high tone is best, and if necessary juggle with C6 or R2, or both, to obtain this. The supply need not be 9 V. The phones put across R1 will show how this works, and two flying leads are soldered on to go to the bridge part of the unit.

Bridge

The 5-way switch selects any capacitor C1 to C5. Without using the extreme settings of VR1, where accuracy falls, the center setting of VR1 is obtained when Cx is the same as C1, C2 or so on. As an example, if C3, 0.01 uF is in circuit, the middle setting of VR1 balances the bridge at 0.01 uF for Cx. From here, the swing of VR1 goes from one-tenth to ten times, so that this range is 0.001 uF to 0.1 uF.

In the same way, C2 (1000 pF) gives a range of 100-10,000 pF, while C4 gives 0.01-1 uF, and C5 gives 0.1-10 uF. C1 would by the same token provide 10-1000 pF, but the null or balancing point for VR1, easily audible with larger values, grows a little difficult to hear at the extreme low capacitance end of this scale.

It will be seen that the overlap is such that the same total coverage would be achieved with only C1, C3 and C5. These three ranges would be 10-1000 pF, 0.001-0.1 uF, and 0.1-10 uF. However, the extra capacitors C2 and C4 are well worthwhile, to fill in for easy checking.

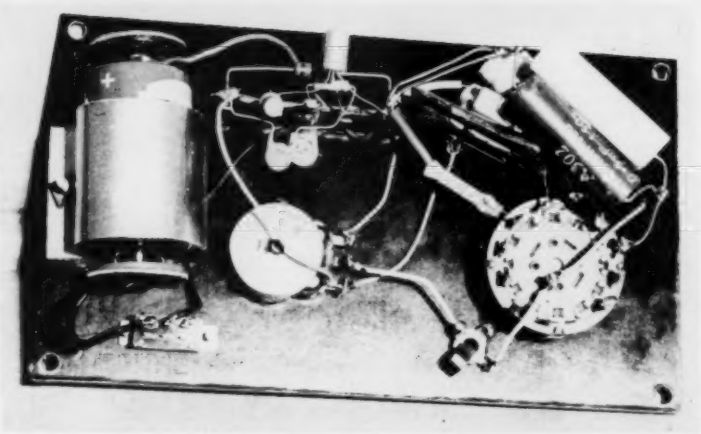
C1 and C2 should be silver mica 1 percent items. For C3, a 2 percent or 5 percent item will probably have to be adopted. C4 may be difficult to get with better accuracy than 10 percent, unless costly, while C5 is actually two 0.5 uF tubulars in parallel. This means that calibration can be accurate for the lower values, but is less so for high values. In any case much accuracy is often not necessary with large values, except possibly in audio filters and some other applications.

These items are grouped mainly round the switch, and the layout shown allows convenient wiring with the capacitors supported by a near tag of the audio oscillator section.

Case Etc.

A plastic box about 6 x 4 x 2 inches with insulated panel is most suitable. It carries an outlet for the phones, on-off switch, two terminals for Cx and a bracket to clamp the battery in position.

The scale for VR1 is marked 100 pF to 10k pF for C2 range, and 0.01 uF to 1 uF for C4 range. The switch is marked pF and uF for direct reading of these ranges, and for uF x 10, uF ÷ 10, and pF ÷ 10 for the other ranges.



Interior view.

Calibration is carried out on the C2 range, with several known capacitors, perferably 1 percent, such as 100 pF, 250 pF, 500 pF and a few others. Values can be obtained by paralleling some, such as 250 and 100 for 350 pF, while switching to C1 range allows the 100 pF, 250 pF and other low values to be used again, for what will be 1000 pF, 2500 pF and similar 10x values on the C2 range.

No calibration is made for the large capacitor ranges, as these will be progressively 10x the existing ranges (assuming C3, C4 and C5 are accurate enough).

A clip or two on short leads from the terminals will be handy for some capacitors. Simply rotate VR1 for the null, and read the value on the scale. High impedance phones, in the 2k to 4k range, will be best. A dip but no real null shows leakage, and is to be expected with electrolytic capacitors. ■

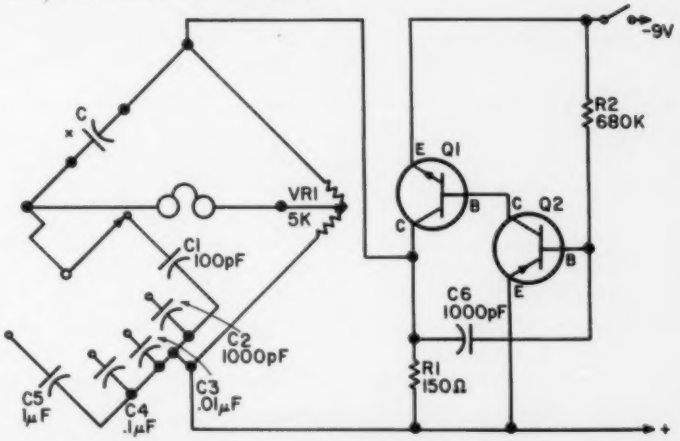


Fig. 1. This is the whole circuit, which isn't much.

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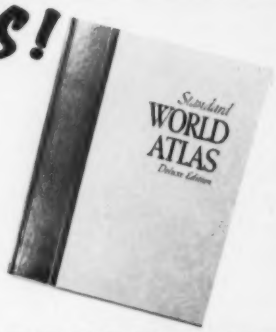

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by
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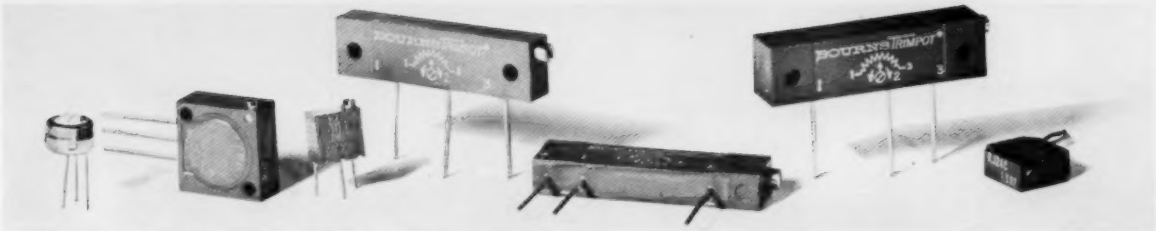
There are many good buys in potentiometers to be found on the surplus market. Some of these are of the adjustment and precision types, forms of pots that are precisely settable and manufactured to exacting specifications. This article will describe basic characteristics of adjustment pots, methods for identifying usable units and simple tests to make sure they are functioning properly.

A potentiometer is a variable resistor used to adjust voltages in electronic circuits. It is composed of a



resistive element, whose total resistance is the value used for identification purposes. A current flows through the resistance creating a voltage drop across the resistor, and a movable wiper contact is driven from one end of the resistance to the other, thereby tapping the resistance to obtain the desired voltage.

Adjustment potentiometers are made by several major electronics components manufacturers. Surplus circuit boards often contain pots of varying styles and resistance, thereby offering a variety of additions to the junk box.

The most common type of pot is the single turn panel mount used for repetitive adjustment purposes such as volume, squelch, etc. These are turned with a knob, screwdriver, allen wrench or the bare finger routine, and are adjusted from end to end in one turn or less.

Precision pots are also panel mounted and knob adjustable. However, they are made of multiple turn design which permits the use of a long, coiled resistance element. As the pot is adjusted, the wiper spirals along the coils permitting great precision and settability. Precisions are often mounted with a clock or digital readout dial, thereby allowing exact resetting.

An adjustment pot operates on a screw and gear reduction principle, with multiple revolutions of the adjustment screw being required to drive the wiper from one end of the resistance to another. Since they have a shorter resistance

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3. 6.04T	11. 6.145T	19. 6.22T	27. 6.34T	35. 6.55T	43. 7.06R	51. 7.18R	59. 7.30R	
4. 6.64R	12. 6.745R	20. 6.82R	28. 6.94R	36. 6.55R	44. 7.69T	52. 7.81T	60. 7.93T	
5. 6.07T	13. 6.16T	21. 6.25T	29. 6.37T	37. 6.94T	45. 7.09R	53. 7.21R	61. 7.33R	
6. 6.67R	14. 6.76R	22. 6.85R	30. 6.97R	38. 7.60T	46. 7.72T	54. 7.84T	62. 7.96T	
7. 6.10T	15. 6.175T	23. 6.28T	31. 6.40T	39. 7.00R	47. 7.12R	55. 7.24R	63. 7.36R	
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Table 1.

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element, their precision falls between the multi-turn and the panel control. Additionally, most adjustment pots contain a clutch mechanism at the end of wiper travel to prevent internal damage, which could result due to the mechanical advantage of the gear reduction system. Leadscrew versions are driven linearly with a machined leadscrew, in the same manner as the tool holder of a lathe. Worm gears have the resistance element formed in a circular manner, and contain a worm driving a gear to produce the circular motion of the wiper. Space, mounting requirements, electrical specifications and function are the prime determinants in the selection of which type to use.

The most common types of pots have resistance elements made of carbon, cermet, conductive plastic and wire. The carbon pot is most often found in panel mounting controls. They are made by depositing a carbon based resistance compound on a dielectric mandrel. Carbons can be made in very high resistances, have a negative temperature coefficient, and tend to absorb moisture.

The cermet pot is made by printing a proprietary suspension on a ceramic substrate. This type is rapidly replacing the carbon pot due to superior electrical and mechanical performance, plus manufacturing cost advantages. They withstand elevated temperatures, offer long mechanical cycle life and infinite resolution.

Conductive plastic is quite similar to cermet, and represents the latest development in pots. The resistive ink is chemical in nature rather than a suspension.

The wirewound pot is made by winding a very small diameter wire on a dielectric

or insulated mandrel, which is then formed to fit within the configuration of the finished unit. The resistance per foot of the wire is translated into the number of turns of wire required to produce a predetermined total resistance for a given diameter and length of element. Destructive analysis of a 10 Ohm and a 50k Ohm wirewound would show much larger diameter wire more widely spaced in the 10 Ohm than in the 50k. The wire in the 50k will actually be smaller in diameter than human hair.

Generally speaking, wirewound pots are used in applications requiring high power handling capability, stability of setting, and low temperature coefficient characteristics. Carbons, cermets and conductive plastics permit infinite resolution, stability of setting, better high frequency performance than wirewounds, and are available in a very broad range of resistances and tapers. They are lower in cost than wirewounds.

Before we go further into identification and testing, let's look at definitions for some of the terms already used and those to come later. These are the most common terms affecting the casual user.

Resistance (Ohms)	Code
10	100
20	200
50	500
100	101
200	201
500	501
1k	102
2k	202
5k	502
10k	103
20k	203
50k	503
100k	104
200k	204
500k	504
1 Meg	105
2 Meg	205
5 Meg	505

Table 2. Resistance Codes.

Total Resistance (TR): The resistive value in Ohms of the entire pot. Omitting the variable wiper tap, the pot could be used as this value of fixed resistor.

Resistance Tolerance: The variation from nominal value in Ohms, usually specified as a percentage. A 50k Ohm unit with a tolerance of ±10% could have a value between 45k and 55k.

Power Rating: The power in Watts which the pot is capable of dissipating at a specified temperature. Use Ohm's law to calculate the power dissipated in a particular situation. The power dissipation capacity will be reduced at elevated temperatures.

Maximum Operating Temperature (MOT): The highest temperature at which the pot is rated to function.

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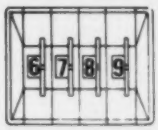

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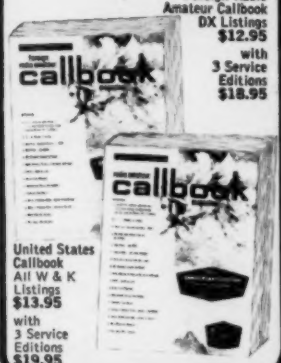

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Higher temperature, either internal or ambient, may result in electrical characteristic changes, and/or electrical or mechanical failure.

Resolution: The minimum change in resistance that can be obtained in adjusting the pot. It is infinite in the case of a continuous strip resistance such as the cermet. In a wirewound, it is dependent upon the number of turns of wire that are in contact with the wiper, and the change in resistance per turn of wire.

Contact Resistance Variation (CRV): The change in resistance seen by the wiper circuit attributable to the movement of the wiper. It is specified as a percentage of the total resistance. This can be demonstrated by connecting a wiper to the vertical amplifier of an oscilloscope. Using a slow horizontal sweep rate, turn the adjustment screw at a constant rate. This will produce a slanted trace which shows the voltage drop seen by the wiper from one end of the resistance to the other. However, at the instant the screw is started and stopped, there will be a sharp vertical deflection of the trace. This represents the added resistance in the circuit caused by the movement of the wiper over the resistance material. Special circuits can also be constructed to show the short time duration spikes which occur during adjustment. A storage scope is of great use in this testing.

Minimum End Resistance: The smallest resistance obtainable when measured between a TR pin and the wiper, with the wiper driven to the end of its mechanical travel. It is expressed as a percentage of total resistance, or in Ohms. Ideally, it is zero Ohms, but in practice will not reach this value due to contact resistance within the pot or physical factors of construction.

Nominal Turns Adjustment: The average number of revolutions of the adjustment screw needed to drive the wiper from one end of the resistance to the other.

Temperature Coefficient: The change in resistance per degree change in temperature, expressed in parts per million (ppm). Typically, the temperature range is −55°C to +150°C.

Taper: A term describing the change in resistance per unit advancement of the wiper. The taper is linear when the change in resistance is uniform with respect to wiper advancement. Just about any taper can be made.

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MC1536T	Op Amp	1.35

operate satisfactorily in a wide variation of ambient conditions, and may be successfully post coated after assembly to the circuit board. Will be stated as yes or no in the specification sheet.

Noise: A discontinuity between the wiper and resistive element experienced as the wiper is driven along the resistance. It would be observed in the same test set up for CRV as a sharp vertical deflection or discontinuity on the scope. Manufacturers establish QC criteria relating to permissible voltage variations and time durations. Everyone has experienced this in the extreme form of a noisy volume control.

DESC: Defense Electronic Supply Center. The agency which sets Mil-Specs for all electronic components, and verifies performance to these requirements.

Qualified Parts List (QPL): A listing of manufacturers qualified by test and performance verification to produce potentiometers listed in the Mil-Specs. Letter designators are listed on the pot to indicate the level of qualification (number of successful hours of testing without failure exceeding prescribed limits).

When you obtain a surplus pot, you will find it marked with either the manufacturer's model number or the Mil-Spec designation. In some cases both the Mil-Spec designation and the manufacturer's model number may appear on the pot. In this case, it is obvious that the manufacturer uses the same basic design to fill both markets, although the exact specs and quality control testing for each group may be different. It should be noted that Mil-Spec requirements are minimums that a pot must meet. It is possible to exceed these requirements in regular production.

A manufacturer introduces any model potentiometer for which he feels there is a market. However, in the case of Mil-Specs, there are only certain model classifications. These relate to physical size, type of resistive element, and electrical/mechanical specs. This permits standardization

Table 3. Key to terminal types.

Type	Description
J	J Hook Solder Lugs
L	Insulated Stranded Leads
S	Solder Lugs
P,T,Y	Printed Circuit Pins (flat mtg.)
W	Printed Circuit Pins (edge mtg.) with screw parallel to pins
X	Printed Circuit Pins (edge mtg.) with screw at right angles to pins
Y	Printed Circuit Pins (staggered – flat mtg.)

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KM6	AH7
KP4	AJ4
KP6	AI0
KS4	AH4
KS6	AH3
KV4	AJ3
KW6	AG7

QSL CARDS, 73 MAGAZINE, Peterborough NH 03458

Qualification Level	% Failures per 1000 hours load life test
M	1.0
P	0.1
R	0.01
S	0.001

Table 4. Key to failure rates (established reliability).

within the military electronics market.

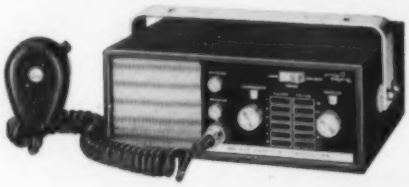
To be listed on the QPL for a given designation, a manufacturer must produce pots which will meet all of the applicable Mil-Specs, in test conditions supervised by DESC. Once listing on the QPL is obtained, the manufacturer must periodically retest production units in each designation to insure continued compliance. Additionally, there are different levels of qualification which relate to the total number of hours test units have been functioning under specified electrical load conditions without failures exceeding a set rate. The qualification level, as we will see later, is marked on each Mil-Spec unit. Most manufacturers also conduct a similar program of recertification for their own models.

Each potentiometer model is manufactured in several different mounting configurations. This permits the utmost flexibility for the circuit board designer. Basically, these involve the orientation of the adjustment screw with respect to the terminal pins, the spacing and shape of the pins, and the physical dimensions of the pot. It is also possible to buy pots with wire leads, thereby permitting mounting of numerous assemblies at a location convenient for service adjustment. Rarely will the operating characteristics of the same model vary between pin styles.

Now that we have the basics down, let's pick up a pot and learn how to identify it. We'll start with some Mil-Spec units, which are the most often encountered type.

Tables are included to explain the coding. The breakdown between wirewound and non-wirewound is evident, together with the additional R in the established reliability group. Each type will also have a date code, such as "7426A." This means the twenty-sixth week of 1974, and the letter indicates manufacturing plant location, which can be obtained from the QPL.

Regency HR-212



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73 BICENTENNIAL SUBSCRIPTION AD
p.19

There is another grouping of Mil-Spec pots known as the Established Reliability group. These are upgrades of the regular DESC models, and must continually pass the most exacting tests. Table 4 contains an explanation of the failure rates.

All pots also have an electrical schematic printed or molded on them. This enables you to mount the pot correctly and know which way to turn the adjustment screw for the desired effect.

Were you to obtain the same pot produced as the manufacturers' model, it would be labeled as "3290-1-101," or in the non-wirewound, "3292P-1-101," in the case of Bourns. The model numbers have been substituted for the RT/RJ, -1 indicates it is the normal production version of this model, and P and 101 have the same meaning as in the DESC version. Some pots may also have the resistance printed in plain language.

Pots are often made with special characteristics or testing for specific customers. In such a case, the -1 would be changed to an identification number unique to that customer. Although you are apt to find such units on surplus boards, there is no way to interpret these markings, and the unit will have to be tested to determine if it is usable in your particular application. In most cases, it will be, since many of these pots have had only special testing or electrical preconditioning.

Now that we can identify what we have, let's move on to some simple tests that will let you know if the pot is usable. All of these can be performed with an ohmmeter.

Set the ohmmeter range to coincide with the TR code of the pot and measure TR by connecting to the two appropriate pins, as indicated by the schematic. Remember to account for the TR tolerance per our definitions. If you are unable to get a reading, switch the meter successively to different ranges. No reading on any range indicates an open pot, which is useless. If a reading is obtained on a different range, the pot may be misprinted, or there may be an electrical malfunction within the unit. We will see how to determine which of these is the case further along.

Now switch one of the ohmmeter probes to the wiper pin, leaving the other on one TR pin. A change in resistance as the adjustment screw is turned should be noted. If a change does not occur, the wiper is not driving, and the pot is useful only as a fixed resistor.

Continued

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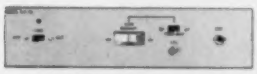

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	F	±100 ppm	85°C	150°C
	H	±50 ppm	85°C	150°C
	J	±10 ppm	85°C	150°C
Wirewound	C2	±50 ppm	85°C	150°C
	D (ER Only)	±50 ppm	85°C	150°C

Table 5. Resistance-Temperature Characteristic.

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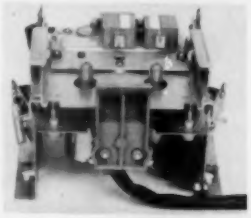

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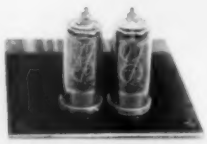

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Without changing the ohmmeter connections, turn the adjustment screw until the resistance indicated goes to zero. Now, turn the adjustment screw at a uniform rate until the resistance indicated reaches the TR value. If the resistance change from zero to maximum occurs uniformly with revolutions of the adjustment screw, the unit has a linear taper and is functioning properly. Watch for equal resistance changes per screw revolution, rather than uniform meter movement, since most ohmmeter scales are non-linear. Various tapers can be determined by plotting resistance change vs. screw revolutions.

If a unit whose measured TR did not agree with that printed on the case were tested in this manner and showed a sudden change in resistance under this test, we would have a defect within the pot which is causing a large resistance change at one point along the resistive element. These pots should not be used, as changes in TR with environmental or internal temperature variations may occur. Such failures can occur due to broken substrates, broken wires or numerous other failure modes. Dissection of the pot and subsequent tracking of the ohmmeter probe along the resistor would reveal the defect location.

Connect the ohmmeter lead simultaneously to all three terminals and the other lead to the adjustment screw. There should be no continuity. This test may be repeated several times while you are checking drive. Indication of continuity would mean electrical contact between wiper and screw, resulting in an electrically active screw and a potential for circuit damage or electrical shock.

The ohmmeter may or

may not be able to detect noise within the pot, depending upon time duration of the wiper discontinuity or damping of the meter. A short term deflection of the meter towards infinity is an indicator of noise. It can most readily be observed while turning the adjustment screw slowly. Unless noise extends over the entire resistance, the serviceability for amateur use is not seriously affected, since it is unlikely that the wiper would have to be positioned exactly at that point.

With the general information, definitions, tables of characteristics, and tests which we have developed, you are set to identify, test and use surplus pots. In home brew work, the choice of which pot to use in a given application usually is controlled by what is on hand more than operating parameters. I would suggest only a few guidelines.

If you are dealing with frequencies above audio, stay away from wirewounds. They make excellent inductors, with very unpredictable results. Check the power requirements which will be needed against the manufacturers' or DESC specs, and don't exceed them. By the way, the catalogs of major electronic supply houses are excellent sources to obtain the manufacturers' basic specs.

The MOT of many pots is close to the maximum temperature that internal components can stand without failure. Overloading the pot will raise its temperature, inviting failure. Choose a pin style that will fit neatly on the circuit or perf board and provide easy access for adjustment. If the pot has to be buried in a sandwich, use a wire lead model.

Adjustment potentiometers are rugged devices, so only moderate care need be exercised in mounting to circuit boards. All pots have high solderability requirements for the terminals, since they are usually wave soldered to boards. Surplus pots may show degraded solderability due to contaminants on the pins. These may be cleaned with freon or isopropyl alcohol prior to use. The flux contained in the solder core should do the remainder of the cleaning job.

As with all electrical components, there are a lot of specs that the normal user is never concerned with. I've listed only the most common ones in this article, leaving it to the individual to acquire other information if the situation warrants. Good luck and happy building using adjustment potentiometers. ■

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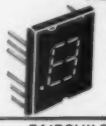

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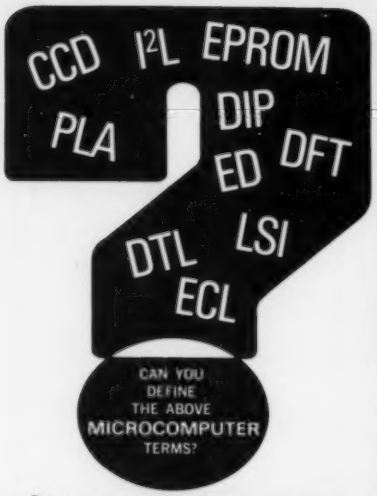

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PHONE ORDERS — (415) 592-8097

74LS00 TTL

74LS00	.30	74LS55	.30	74LS151	1.55
74LS02	.30	74LS73	.65	74LS153	1.89
74LS03	.30	74LS74	.65	74LS157	1.55
74LS04	.45	74LS75	.79	74LS162	2.25
74LS05	.45	74LS76	.65	74LS163	2.25
74LS08	.30	74LS83	2.19	74LS164	2.25
74LS10	.30	74LS86	.85	74LS181	3.69
74LS13	.79	74LS90	1.25	74LS190	2.85
74LS14	2.19	74LS92	1.25	74LS191	2.85
74LS20	.30	74LS93	1.25	74LS192	2.85
74LS38	.49	74LS95	2.19	74LS193	2.85
74LS27	.49	74LS96	1.69	74LS194	2.25
74LS28	.49	74LS107	.65	74LS195	2.25
74LS30	.30	74LS112	.65	74LS257	1.89
74LS32	.45	74LS132	1.55	74LS260	.55
74LS40	.49	74LS136	.65	74LS279	.79
74LS51	.30	74LS138	1.89	74LS670	8.95

DIP SWITCH
These switches feature four SPST Rocker Switches in a molded dip. They are ideally suited for microprocessor applications. **$1.95**

MINATURE TOGGLE

DPST				.047	1	2-9	10-29	30-99
	ON	OFF	ON	221	3.09	2.80	1.97	1.38
	ON	NONE	ON	223	2.66	2.35	1.68	1.01
	ON	OFF	ON	171	2.35	1.95	1.43	1.30
	ON	NONE	ON	123	2.05	1.65	1.21	1.10

PUSH BUTTON

DPDT – CONNES PB, PBT

Illuminated Action Switch	Model Number	1 Each	Quantity net prices 2-9	10-29	30-99
Push To Make Contact. And Push Again To Release Action	PB-123	$2.35	$1.95	$1.47	$1.30
Momentary Action Switch Normally Open or Normally Closed. (Pair In C circuit use terminals 2 & 1 for N.O. 2 & 3 for N.C and N.O. 1,2,&3	PB-126	$2.35	$1.95	$1.47	$1.30

3 AMP RATINGS

THUMBWHEEL SWITCHES

THUMBWHEEL SWITCH ONLY
SF – Front Mount, SR – Rear Mount

Part No.	Description	Price
SF 10	Single Pole 10 Position	$7.95
SR 12	Decimal	3.95
SF 21	10 Position BCD only	7.95
SR 21		3.95

Ordering: Order desired switch or switches and add necessary accessories for your particular application.

SF/SR 10 Front/Rear Mount Decimal

SF/SR 21 Front/Rear Mount BCD

ACCESSORIES

Part No.	Description	Price
SF DP	End Plate (pair)	$.50
SF DP	Divider Plate (each)	.40
SF BB	Blank Body (each)	.40
SR HB	Half Body (each)	.40

ACCESSORIES

Part No.	Description	Price
SR EP	End Plates (pair)	$.50
SR DP	Divider Plate (each)	.40
SR BB	Blank Body (each)	.40
SR HB	Half Body (each)	.40

8 POSITION ROTARY SWITCH
These switches are a 7 position, one position open, rotary switch enclosed in a TO-5 can. They have a standard 8 pin configuration and will mount perfectly on printed circuit board. **$.99 ea.**

ZENERS—DIODES—RECTIFIERS

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
1N746	3.3	400m	4/1.00	1N4003	200 PIV	1 AMP	12/1.00
1N751A	5.1	400m	4/1.00	1N4004	400 PIV	1 AMP	12/1.00
1N752	5.6	400m	4/1.00	1N2680	50	250m	6/1.00
1P753	6.2	400m	4/1.00	1N4148	75	10m	15/1.00
1N754	6.8	400m	4/1.00	1N4149	50	10m	12/1.00
1N5985B	10	400m	4/1.00	1N4734	5.6	1w	29
1N5232	5.6	500m	39	1N4735	6.2	1w	29
1N5234	6.2	500m	39	1N4736	6.8	1w	29
1N5235	6.8	500m	39	1N4737	7.5	1w	29
1N5236	7.5	500m	39	1N4742	12	1w	29
1N486	25	40m	6/1.00	1N4744	15	1w	29
1N456	150	7m	6/1.00	1N1183	50 PIV	35 AMP	1.60
1N4148	100	10m	5/1.00	1N1184	100 PIV	35 AMP	1.70
1N4001	50 PIV	1 AMP	12/1.00	1N1186	300 PIV	35 AMP	1.80
1N4002	100 PIV	1 AMP	12/1.00	1N1188	400 PIV	35 AMP	3.00

TRANSISTORS

MPS A05	5/$1.00	PN2907	3/$1.00	PN4046	4/$1.00
MPS A06	5/$1.00	PN2906	4/$1.00	PN2369	4/$1.00
2N2219A	3/$1.00	PN3906	4/$1.00	2N4403	4/$1.00
2N2221	4/$1.00	PN3960	4/$1.00	2N4402	4/$1.00
2N2222A	4/$1.00	2N3702	5/$1.00	2N4403	4/$1.00
2N2369	5/$1.00	2N3705	5/$1.00	2N4409	4/$1.00
2N2369A	4/$1.00	2N3706	5/$1.00	2N4410	4/$1.00
PN2415	5/$1.00	2N3707	5/$1.00	2N5086	4/$1.00
2N2484	4/$1.00	2N3711	5/$1.00	2N5087	4/$1.00
2N2906A	4/$1.00	2N 724	$ .65	2N5088	4/$1.00
2N3967A	5/$1.00	2N 726	.99	2N5089	4/$1.00
2N3903	5/$1.00	2N3903	5/$1.00	2N5129	5/$1.00
2N3904	5/$1.00	2N3904	5/$1.00	2N5172	5/$1.00
2N3905	$ .99	2N3906	4/$1.00	2N5179	5/$1.00
MJE3055	$1.00	2N3965	4/$1.00	2N5210	4/$1.00
MJE2955	$1.25	2N 743	3/$1.00	2N5551	5/$1.00
2N2060	5/$1.00	2N 744	3/$1.00	C106B1SCR	3/$1.00
2N3055	5/$1.00	2N 834	3/$1.00	2N5432	$2.00

CAPACITOR CORNER

100 VOLT CERAMIC DISC CAPACITORS

	1-9	10-49	50-100		1-9	10-49	50-100
10 pf	.09	.08	.07	.001 µf	.09	.08	.075
22 pf	.09	.08	.08	.0047 µf	.09	.08	.075
47 pf	.09	.08	.08	.01 µf	.09	.08	.075
100 pf	.09	.08	.08	.022 µf	.09	.08	.08
220 pf	.09	.08	.08	.047 µf	.09	.08	.08
470 pf	.09	.08	.075	.1 µf	.12	.09	.075

100 VOLT MYLAR FILM CAPACITORS

.001 mf	.12	.10	.07	.022 mf	.13	.11	.09
.0022	.12	.10	.07	.0470 mf	.21	.17	.13
.0047 mf	.12	.10	.07	1 mf	.27	.23	.17
.01 mf	.12	.10	.07	.22 mf	.33	.27	.22

+ 20% TIPPED TANTALUMS (RELIG) CAPACITORS

.1 35V	.39	.33	.27	1.5 35V	.39	.26	.21
15 35V	.39	.33	.27	2.2 25V	.31	.27	.22
22 35V	.39	.33	.27	3.3 25V	.31	.27	.22
33 35V	.39	.33	.27	4.7 25V	.32	.28	.23
47 35V	.39	.33	.27	6.8 25V	.34	.31	.25
68 35V	.39	.33	.27	10 25V	.40	.35	.29
1.0 35V	.39	.33	.27	15 25V	.53	.50	.40

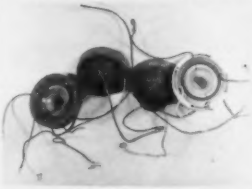
MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS

Axial Lead				Radial Lead			
.47 50V	15	13	10	47 25V	10	.13	10
1.0 50V	16	14	11	47 50V	16	14	11
3.3 50V	16	13	10	1.0 16V	10	.13	10
4.7 25V	15	14	12	1.0 25V	16	14	11
10 25V	15	13	10	1.0 50V	16	14	11
10 50V	16	14	12	4.7 16V	15	13	10
22 25V	17	15	12	4.7 25V	15	13	10
22 50V	24	20	16	4.7 50V	16	14	11
47 25V	19	17	16	10 16V	14	10	.09
47 50V	33	31	30	10 25V	15	13	10
100 25V	30	28	25	10 50V	16	14	12
100 50V	36	32	28	47 50V	24	21	13
220 25V	32	28	25	100 16V	19	16	14
220 50V	45	41	36	100 25V	24	20	18
470 25V	37	35	32	100 50V	35	30	28
1000 16V	36	33	30	220 16V	23	17	15
2200 16V	70	62	55	470 25V	31	28	24

All parts are removed from functioning equipment. Guaranteed functional. If you are building a CRT monitor for any purpose these parts are ideal. Please include $2.00 to cover handling and insurance on all orders. Minimum order $5.00. NO COD. Send check or money order plus estimated shipping. Excess will be refunded.

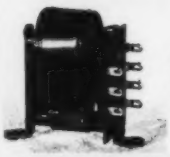
CRT for VDT
12' P31 phosphor, extremely small spot size, approx .002" when properly focused. Removed from functioning VDT — guaranteed wt. 10 lbs. **$14.99**

Socket
Fits above CRT (with leads) wt. ½ lb. **$.99**



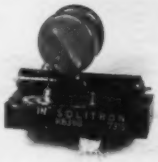
Yoke
For above CRT — less than .1 ohm dc resistance, very low inductance perfect for high deflection rates and write speeds. Used in modern VDT for stroke-type graphics and alphanumerics. Perfect for any VDT, SSTV or similar monitor. With four long leads and connectors. Wt. 4 lbs. **$12.99**

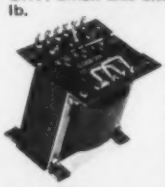
High Voltage Power Supply **NEW!**
This is a unit designed & manufactured by SUNTRONIX using component parts from the (Sanders) 708 Display. Generates 15 kVdc, 950 Vdc & -150 Vdc for the above CRT. Includes socket for CRT, connector for input voltages, high voltage lead and connector for the CRT anode and requires no input drive signal — self starting. Needs + and - 15 Vdc and + E Vdc. Ideal for the monitor or VDT you're building. This is NOT the Sanders HVPS, but a brand new design utilizing component parts from the Sanders HVPS. Wt. 6 lbs. **$19.99**



HVPS XFMR
This is a fly-back type transformer and is used in the SUNTRONIX HVPS described above. We'll supply schematic information for constructing your own HVPS. Wt. 3 lbs. **$5.99**

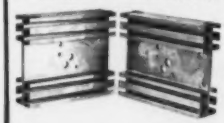
HVPS Rectifies Assy
This little gem will take 15kV ac and turn it into 15 kVdc, filtered and ready for the CRT. Small size and SOLID STATE. Wt. ½ lb. **$3.99**





Low Voltage Power XFMR
Provides all low voltages needed by the homebrew VDT or monitor. Dual 115 Vac primary, 30 Vac, 22 Vac and 12 Vac, all C.T. and 10A, 5A and 2A output currents respectively. Wt. 8 lbs. **$8.99**

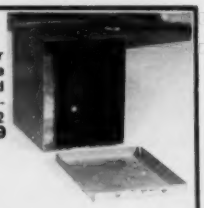
Filter Caps
Two values — 36,000 @ 30 Vdc and 47,000 @ 25 Vdc. Should use two of each for a + and - 15 Vdc and + 5 Vdc supply. Wt. 2 lbs. ea. **$1.99 ea.**

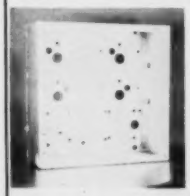


Heat Sinks
Four of these were used in the deflection amplifiers. Each sink will handle approx. 150 watts drilled for T0-3 transistor. Wt. 2 lbs. ea. **$1.99**

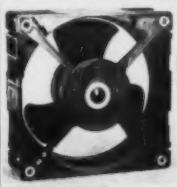
Transistors
LVPS pass transistors J2267 & MJ2255; each good for 150 watts @ 40 vcbe. Deflection output transistors 2N5301 & 2N4398 also 150 watt units. **$1.99 ea.**

Mu-Metal Box w/cover
This is a must if you plan to mount your power supply xfmr on the same chassis as the CRT. XFMR above fits this box perfectly and will prevent problems with magnetic interference between the CRT and XFMR. Wt. 2 lbs. **$2.99**



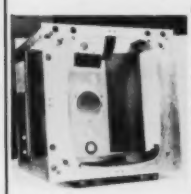


Power Supply Case
This is the Cadmium-plated power supply enclosure used on the 708. Made of steel, cadmium plated for corrosion resistance and magnetically shielded. Supplied with front and rear covers. All holes drilled to install the above LVPS components. Available with three bridge rectifiers, three pass transistors and input/output plugs or stripped. wt. w/covers 10 lbs. — without covers and rectifier parts. Wt. 8 lbs. **$8.99**



Muffin Fan
4" ROTRON muffin fan for cooling those warm transistors. Wt. 3 lbs. **$3.99**

XFMR IC PS
Completely enclosed with long leads. 115 Vac primary, 12 Vac @ 3.0A and 135 Vac @ 50 mA. Good for general purpose bench supply and for high voltage requirements for nixie or gas-discharge displays. Wt. 3 lbs. **$3.99**



CRT Chassis
This is the basic enclosure for a 12' CRT. Includes front mounting plate to hold the CRT (with metal mounting ring), plastic decorative bezel that clips into front plate and provision for mounting the yoke (above). Has plenty of additional space for support electronics and provision for mounting the LVPS enclosure described above. Will save you days of sheet metal work. Available with or without bottom mounting base and plate. With, wt. 15 lbs.; without, wt. 10 lbs.

Cover
This is the wrap-around cover for the above components. Painted, has hinged rear cover plate for easy access to internal components. wt. 15 lbs. **$7.99**

Sanders Keyboard
This is the Sanders 720 ASCII keyboard so much in demand and now available at this low price only from SUNTRONIX. These units are of various configurations; some have numeric pads separate from the main keyboard, others have the numbers as part of the keyboard with control functions as a separate grouping. Sorry — no choice available. All units sold as-is and priced for a quick sell-out. As before, when these are gone, there will not likely be more . . . order early to avoid missing out. Wt. 9 lbs. **$39.99**

Suntronix Keyboard KBD IV
This is a brand new SUNTRONIX designed and manufactured unit described in the last several issues of 73. These units are rapidly becoming the standard keyboard for many of the Mup units being offered by others. Naturally, their price includes their mark up on the KBD-IV. Save a few dollars and order from the designer direct. Sorry, due to lack of interest kits are no longer available. Factory assembled units will be sent postpaid for $74.95. Naturally, the unconditional 90 day warranty applies along with full documentation and factory back-up. **$74.99**

All prices are subject to change without notice. Availability on some items is limited. All items are subject to prior sale. No backorders — if we're out of stock for any reason your money will be instantly refunded. Master Charge and BankAmericard accepted. All prices are F.O.B. Lawrence, Massachusetts (you pay shipping). SASE for info.

SUNTRONIX COMPANY

360 Merrimack St., Lawrence, Mass. 01843
Factory Telephone 617-688-0751

master charge
BANKAMERICARD

COLLINS R-388/URR RECEIVER, military version of the 51J-3, tunes 500 kHz to 30.5 MHz, 19" rack mount, 115 V/60 Hz $345.00

COLLINS R-388A/URR RECEIVER, military version of the 51J-4, has switch for mechanical filters, tunes 500 kHz to 30.5 MHz, 19" rack mount 115 V/60 Hz 475.00

COLLINS R-389/URR VLF RECEIVER, tunes 15 kHz to 1500 kHz, digital readout, 115 V/60 Hz 550.00

R-390/URR RECEIVER, tunes 500 kHz thru 30.5 MHz digital tuning, dual rf, audio filters, 115 V/60 Hz, 19" rack mount 450.00

R-390A/URR RECEIVER, tunes 500 kHz thru 30.5 MHz, mechanical filters, 115 V/60 Hz 19" rack mount .. 650.00

HAMMARLUND SP-600JX, tunes 540 kHz to 54 MHz in 6 bands, 115 V/60 Hz, 19" rack mount 375.00

URR-13 RECEIVER, tunable UHF 225-400 MHz, used to monitor military and satellite frequencies, 115 V/60 Hz 145.00

R-109/GRC RECEIVER, 27 to 38.9 MHz FM 28 V, tunable 24.50

BC-348 RECEIVER, tunes 200-500 kHz and 1.5 to 18 MHz, 28 V, easily converts to 115 V/60 Hz by building a power supply 65.00

BENDIX MN-26C RADIO COMPASS RECEIVER, 28 V, 150 thru 1500 kHz 18.50

ARN-14 OMNI RECEIVER, 108.1 to 135.9 MHz, synthesized, complete with mount and control head 39.50

BC-733 RECEIVER, 108-110 MHz crystal controlled aircraft receiver, 28 V 7.50

ARN-5 GLIDEPATH AIRCRAFT RECEIVER, 332-335 MHz, 28 Vdc, crystal controlled 9.50

R-19/TRC-1 FM RECEIVER, 70-100 MHz 115 V/60 Hz 19.50

COMMUNICATIONS ELECTRONICS CO. TYPE 901-1 RECEIVER, tunable 30-60 MHz and 60-300 MHz in two bands, AM/FM/CW 300 kHz and 20 kHz bandwidth, S meter, 19" rack mount 225.00

PRC-6 ARMY HANDIE TALKIE, 47 to 56 MHz complete with antenna, less battery 28.50

RT-294/ARC-44 MILITARY FM AIRCRAFT TRANSCEIVER 24.0 thru 51.9 MHz, 280 channels, synthesized, 8 Watts output take 28 Vdc with control head 45.00

SG-3/U FM SIGNAL GENERATOR by Measurements Corp., covers 50 MHz thru 400 MHz in 3 bands, 01 to 100,000 M/V calibrated output fully metered, a late military type generator for FM alignment in the amateur, marine and commercial field, 115 V/60 Hz 375.00

MODEL VOX-2, Technical Material Corp., variable frequency oscillator, tunable 2 thru 64 MHz, oven controlled, 115 V/60 Hz 85.00

FREQUENCY COUNTER FR114/U, 20 Hz – 1 MHz 6 digit Nixie readout, ideal for low frequency or audio work, a scaler could be designed to operate in higher ranges to cover amateur or commercial frequencies – a beautiful counter, govt. cost $3,800.00 ..... 85.00

ELECTRO MODEL NF FILTERED DC BENCH POWER SUPPLY, metered 0-50 Vdc and 0-25 amps dc, variable pot. Size 9½H x 14W x 14L, ideal power supply to run 12 or 28 Volt equipment, filtered for transistor work 95.00

BALLANTINE 300 AC VTVM, 10 Hz to 150 kHz range, 1 mV to 100 V in 5 ranges, logarithmic scale 1-10 dB, accuracy 2% 32.50

SG-34/GPM-15 LORAN TEST SET, use to calibrate and test all Loran a/c receivers 115 V/60 Hz 125.00

OSCILLOSCOPE PLUG-INS, TEK Type H, K. Lavoie LA545/-54D, Hickok 1824, 1825, 1832 ..... 45.00

AN/PRM-1 RADIO INTERFERENCE AND FIELD INTENSITY METER, range 150 kHz – 25 MHz, sensitivity 1 mV 185.00

PRM-10 GRID-DIP OSCILLATOR, 2 MHz thru 400 MHz, perfect for antenna work 65.00

TS-175/U FREQUENCY METER, 85 kHz to 1000 MHz high frequency version of the BC-221 with original calibration book 75.00

HP-400D VTVM, a popular lab instrument, ac 1 mV to 300 V, 10 Hz to 4 MHz 69.50

BOONTON 260A Q METER, 50 kHz to 50 MHz .. 225.00

NEW LONDON 257A FM MODULATION DEVIATION METER, 20 MHz thru 1000 MHz 145.00

B & K MODEL 1075 TELEVISION ANALYST, a flying spot scanner, ideal for slow scan 135.00

TEKTRONIX 525 TELEVISION WAVE FORM MONITOR OSCILLOSCOPE. Used to monitor video wave forms165.00

BIRD IM-89/UR SWR INDICATOR, 200-400 MHz, 0-50 Watts 1 to 6 swr UHF version of the model 43 ..... 65.00

FR-4/U FREQUENCY METER, replaced by Military BC-221, range 100 kHz thru 20 MHz, has built-in scope and audio oscillator heterodyne unit that generates 100 mV output at 50 Ohms .001 accuracy, with calibration book 65.00

TS-230E RADAR TEST SET, measures power and frequency range 8500-9700 MHz 39.50

TS-505/U VTVM, 0-250 Vac, 0-100 Vdc, 0-100 M resistance, ac frequency response 30 Hz to 500 MHz, high input impedance, portable ruggedized construction, complete with probe 45.00

HP-185B OSCILLOSCOPE with 187B dual trace amplifier, dc to 1000 MHz 10 mV – 200 mV/cm, timebase 10 NSEL-10 PSEC +X2, X5, X10, X20, X50, X100 magnifier, sweep rate 40 PSEC 350.00

HP-410B VTVM, ac 0-300 V, dc 0-1000 V Ohms 0.2 to 500 milliohm, freq 20 Hz to 700 MHz 85.00

TEKTRONIX 181 TIME MARK GENERATOR 95.00

HP-614A SIGNAL GENERATOR, 900-2100 MHz, metered modulation and calibrated output 195.00

MEASUREMENTS 82 SIGNAL GENERATOR, freq. range 20 Hz to 200 kHz in 4 ranges and 80 kHz to 50 MHz in 7 ranges, output 0 to 50 Volts mod 0-50%, ideal for VLF/HF work 225.00

SG-103/URM-25F SIGNAL GENERATOR, 10 kHz thru 50 MHz in 8 bands, calibrated output, crystal calibrator, modulation 400, 1000 Hz 0-80% 275.00

LAMPKIN PPM CRYSTAL CALIBRATOR, goes with Lampkin 105B 45.00

TS-730/URM SUMMATION BRIDGE AND POWER METER, range 20 MHz to 10,000 MHz with bolometer mounts, 5 mW to 5 Watts 29.50

BOONTON 190A Q METER, rf range 20 to 260 MHz 195.00

TS-148/UPM-33 SPECTRUM ANALYZER, range 8470 to 9630 MHz, sweep 10-30 Hz 49.50

TS-510A military version of HP608D, range 10 MHz to 420 MHz in 5 bands, calibrated output, crystal calibrator, modulation 400 and 1000 Hz 475.00

HP-202A LOW FREQUENCY FUNCTION GENERATOR, range 0.008 to 1,200 Hz in 5 decade ranges 95.00

TS-497/URR SIGNAL GENERATOR, 6 ranges 2 to 400 MHz, miltary version of the measurements model 80, 0.1 to 100,000 mV 225.00

SG-299D/U SQUARE WAVE GENERATOR, a wide range 1 Hz to 1 MHz continuous coverage, use with any oscilloscope to determine frequency response and phase shift characteristics of video and audio amplifiers, military version of the HP211A 45.00

ME-71/FCC AUDIO GENERATOR, a test instrument which generates sine wave signals over a frequency range of 50 CPS to 500 kHz used for service or development work such as signal tracing, waveform analysis, distortion measurement and acoustical test in audio, supersonic or low VLF ranges 60.00

HP-218 DIGITAL DELAY GENERATOR with 219B dual pulse unit, has variable gate generator for work with digital computers and counters, a time interval generator for calibrating time bases, delay lines and precision sweep delays 175.00

HP-330B DISTORTION ANALYZER, 20 Hz – 20 kHz, built-in VTVM with full scale sensitivities of .03 – 300 Volts in 9 ranges, 10 Hz-100 Hz VTVM response, distortion levels of as low as .1% can be measured with accuracy of 3% 125.00

HP-540A TRANSFER OSCILLATOR, 10 MHz to 12.4 GHz range of freq. measurement, use with any frequency counter covering 100-200 MHz 95.00

HP-561B DIGITAL RECORDER, has a printing speed of five, 11 digit lines per second, uses standard roll paper and standard typewriter ribbon 125.00

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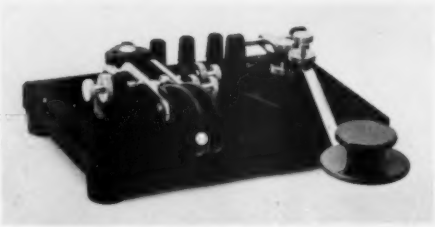

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BARREL KIT #13
POWER TAB TRANSISTORS
40 for $1.98
PNP, plastic TO220 type. Assorted 2N numbers. **Cat. No. 2426** Untested.

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40 for $1.98
Untested.
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Marked and unmarked. Red case type asst. values. **Cat. No. 2430** 100% good.

BARREL KIT #17
LINEAR & 7400 DIPS
Untested
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Marked and unmarked, internal numbers of raw factory stock. **No. 2431**

BARREL KIT #18
ZENER-RECTIFIER MIX
100 for $1.98
Subminiature, DO7's, includes asst. zeners and rectifiers. It's mixed at the factory, we cannot separate. Untested. **Cat. 2432**

BARREL KIT #19
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60 for $1.98
Finest capacitors made, shiny finish. Imagine factory dumping 'em in barrels. **Cat. No. 2897** 100% good.

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60 for $1.98 Untested.
Up to 12,000 volts, 4 mils, epoxy, axial leads. **Cat. No. 2602**

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METAL CAN TRANSISTORS
100 for $1.98 Untested.
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BARREL KIT #26
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100 for $1.98 Untested.
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BARREL KIT #26
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200 for $1.98
Not only do the barrels contain dogbones, but factory dumped, Erie Centralab, molded types too! **Cat. No. 2606** 100% good.

BARREL KIT #26
VITAMIN Q CAPS
100 for $1.98 100% good.
Every type of oil-impregnated cap, some worth $2. But the "ole barrel" sale gives you the bargain-of-a-lifetime. **Cat. No. 2607**

BARREL KIT #30
PREFORMED RESISTORS
200 for $1.98
We got barrels of ¼ and ½ watters for pc use. You'll get even amount. 100: ¼, 100 ½ watters. **Cat. No. 2608** 100% good.

BARREL KIT #31
METALLIC RESISTORS
100 for $1.98
Made mostly by Corning, the finest resistor made. Mostly ½ watters. 1% to 5% tol. & a barrel of values 100% good. **No. 2609**

BARREL KIT #33
TRANSISTORS WITH A HOLE IN IT
50 for $1.98
Cat. No. 2610 Untested.
Can't name factory but we bought barrels of 25 watters with mtg. hole in middle. PNP'S and NPN'S.

BARREL KIT #34
TUBE SOCKETS
100 for $1.98
Good ole tube sockets, still in demand! Barrels and barrels: 4's, 5's, 7, 8, 9, even miniature types. **Cat. No. 2612** 100% good.

BARREL KIT #35
NEON LAMPS
40 for $1.98 100% good.
Famous NE-2's. All prime, but factory made millions and barrel'od 'em. Your advantage. **Cat. 2613**

BARREL KIT #36
GERMANIUM DIODES
200 for $1.98
Famous maker, popular item. Never grows old. But this is the way RE-TESTERS buy 'em from the factories. Untested **Cat. 2614**

BARREL KIT #37
1 AMP "BULLETT" RECTIFIERS
100 for $1.98
Famous style, asstd. voltages, silicon, axial includes all types of voltages to 1KV. Untested **Cat. No. 2615**

BARREL KIT #38
3 AMP RECTIFIERS
75 for $1.98
Untested.
"CYLINDER" type, silicon, Mallory, includes all voltages up to 1KV. Axial leads. **Cat. No. 2616**

BARREL KIT #39
2N3055 HOBBY TRANSISTORS
15 for $1.98 100% good.
From factory to you, these fallouts of the famous 2N3055. We have 10 barrels. **Cat. No. 2617**

BARREL KIT #40
PNP HIGH-POWER TRANSISTORS
20 for $1.98
Popular germanium TO-3 case units, now available at "good ole barrel" prices. **Cat. No. 2618** 100% good.

BARREL KIT #42
100 ITT "GLASS 4000 RECTIFIERS
$1.98 Untested.
Just in! 1N4000 silicon rectifiers in epoxy, now in glass encased axial barrel prices 50 to 1000v too! **Cat. No. 2628**

BARREL KIT #46
G.E. 2.5 WATT AMPLIFIERS
25 for $1.98
Hobby type, factory fallouts, we purchased them in barrels. These are unknowns. **No. 2624** Untested.

BARREL KIT #46
QUADS! QUADS!
50 for $1.98 LM 3900
Untested. 4 mirror op amps in one package. Why the factory barrelled these we don't know. **Cat. No. 2627**

BARREL KIT #59
SIGNAL SILICON DIODES
200 for $1.98
Includes many, many types of switching, signal silicon types, all axial leads. Some may be zeners. **Cat. No. 2628** Untested.

BARREL KIT #51
HOBBY OPTO COUPLERS
30 for $1.98
We bot 1,000's unknown both the sensor or transmitter may be good or both. WE DON'T KNOW! We don't know the types. 1500V isolation. **No. 2629** Untested.

BARREL KIT #52
DISCS!
500 for $1.98
No. 2630 100% good.
The bargain of a lifetime! First time ever offered by Poly Paks for the economy minded bargain hunters.

BARREL KIT #53
JUMBO RESISTOR PAK
100-pc. $1.98
No. 2721
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BARREL KIT #54
9 DIGIT READOUTS
10 for $1.98 Untested.
Bargain of a lifetime! All we got was 1 barrel — the "blinder dixit" types. Multiplexed. **Cat. No. 2722**

BARREL KIT #55
3 DIGIT READOUTS
15 for $1.98
National cleaned its warehouse . . . now we have barrels of NSN-33 type Untested. **Cat. No. 2723**

BARREL KIT #57
HI-POWER RECTIFIERS
15 for $1.98
50-Amp studs: 6, 12, 24, 48V. 100% material. Factory rectifier "line" rejects. **Cat. No. 2725** 100% good.

BARREL KIT #58
SLIDE SWITCHES
30 for $1.98
All shapes, sizes, spst, dpdt, momentarios, etc. Tremendous shop pak for 100's of switching projects. **Cat. No. 2726** 100% good.

BARREL KIT #59
POWER TRANSISTORS
40 for $1.98
15 watt Bonds B-5000 pellet transistors, spa. all good, purchased from a protester, have millions of 100% good. **Cat. No. 2727**

BARREL KIT #60
DTL'S IC'S
75 for $1.98 Untested.
This is prime barrel material. Who wants DTL's? 930, 936, 946's. Your gain is our loss. They're marked too. **Cat. No. 2728**

BARREL KIT #61
POLYSTYRENE CAPS
100% good
100 for $1.98
Finest caps made. As a gamble we bought 10 barrels from factory, mixed values: all good. **Cat. No. 2729**

BARREL KIT #64
6-DIGIT ARRAYS
20 for $1.98
Here's a bargain! This is a National "dump" . . . inflation is stopped here! **Cat. No. 2732** Untested.

BARREL KIT #65
MIXED READOUTS
30 for $1.98
Factory returns — such numbers as MAN-4's, MAN-7's, MAN-3's, 11 barrels & no time to separate. **Cat. No. 2733** Untested.

BARREL KIT #67
2-WATT AMPLIFIERS
50 for $1.98 Untested.
Buy from the barrel 'n save! LM-380 types in dip paks. Are they good? We don't want to find out We got millions. **Cat. No. 2734**

BARREL KIT #68
2 WATTERS
100 for $1.98 100% good.
Nobody seems to want 'em! So many suppliers don't count, but throw 'em in the barrel. It's a lil gold mine. All marked. **Cat. No. 2735**

BARREL KIT #71
CAPACITOR SPECIAL
100 pcs. $1.98
Emptied stockrooms into barrels of mylars, poly's, micas, moldeds, plastics, ceramics, discs, etc. Nifty 100% good. **Cat. 2736**

BARREL KIT #72
TERMINALS, RECEPTACLES
100% good
150 for $1.98
Maker of these dumped into barrels. You get 2, 4, 6 strips & receptacles. What a buy! **Cat. No. 2739**

BARREL KIT #73
TRANSISTOR ELECTROS
50 for $1.98
It "bugs" us why the factories dump 'em in barrels. We don't wish to separate wide asst voltages & values up to 300 mf. **No. 2747**

BARREL KIT #75
400MW ZENERS
100 for $1.98
Factory out of bin! Amazing offer: 6, 8, 10, 12 to 18V. You test. Hermetically sealed glass pak. Double plug. **Cat. No. 2740** Untested.

BARREL KIT #76
1-WATT ZENERS
100 for $1.98 Untested.
Factory same as 400-mw's, Never-to-see-again offer. 6, 8, 10, 12, 18V. under glass. Double plug. **Cat. No. 2741**

BARREL KIT #77
"BROWN" BODY TRANSISTORS
40 for $1.98
G-E D-40 series: has hi-voltage, Darlingtons, hi-current, npn's. Factory line discontinued. Power tabs. **Cat. No. 2742** Untested.

BARREL KIT #78
"RED" BODY TRANSISTORS
40 for $1.98
D-42 series. You test—go into your own biz! High current, hi-V. NPN. **Cat. No. 2743** Untested.

BARREL KIT #79
DARLINGTON POWER TABS
25 for $1.98 Untested.
Brown body, power tab Darlingtons are mixed, raw factory stock. Why pay more? **Cat. No. 2744**

BARREL KIT #81
SUBMINI RESISTORS
100 for $1.98 100% good.
PC, upright type, color coded, ¼ watt. Asst values. Came to us in a barrel. **Cat. No. 2746**

TWIN PAK #1
LED READOUTS
20 for $1.98
10 Man-3's.
10 Man-7's.
Cat. No. 2928

TWIN PAK #4
ZENERS
100 for $1.98
50 400-MW.
50 1-watt
6, 8, 10, 12 to 18V.
Cat. No. 2829

BARREL KIT #82
8000 SERIES ICS
50 for $1.98
By National. From factory to you. Assortment of popular series factory fallouts, overruns. Untested. **Cat. No. 2834**

BARREL KIT #83
15 for $1.98 Untested
LM-340T VOLTAGE REGULATORS
Factory rejected them for length of leads, May include 5, 6, 8, 12, 15, 18, 24 volts. Power tab. **No. 2835**

BARREL KIT #84
25 for $1.98 Untested **MAN-3**
"THE CLAW"; 5V 15 mils. LED hobby or experimental use, for understanding the working of "mini" or calculator readouts. A segment may be missing. **No. 2670**

BARREL KIT #86
HOBBY LEDS
40 for $1.98 Untested.
Wow! A Litronics dump of all kinds of mixed discrete LEDS, shapes, colors, good, poor, etc. **Cat. 2859**

BARREL KIT #87
NATIONAL IC BONANZA
100 for $1.98
Factory dumps into barrels. Types 8000, 7400 series, DTL, ROMs, registers, clock & calc. chips, linears, etc. **Cat. No. 2860** Untested.

TWIN PAK #10
POWER RESISTORS
70 for $1.98
40 Oxide 2-watters.
30 Oxide 7-watters.
Cat. No. 2835

TWIN PAK #9
6 & 9-DIGIT READOUTS
10 6-digit **15 for $1.98**
5 9-digit
Hobby types, from calculator makers' closeouts. **Cat. No. 2834**

BARREL KIT #91
SILVER MICAS
100 for $1.98
For the first time silver micas so low in price! Axial, red case, variety of physical sizes & values. Big savings from distributor prices. Wt. 1 lb.

BARREL KIT #94
"BUBBLE" READOUTS
12 for $1.98
DL-33B bubble magnifiers. Segs missing. Truthfully so many of 'em we don't care. Untested. 3 oz.

BARREL KIT #98
PHOTO ELECTRIC CELLS
10 for $1.98
Asst. CE types, CDS types. Mixed by factory. Big job for us to separate. 100% good.

BARREL KIT #101
RESISTOR SPECIAL
200 for $1.98
Includes: ⅛, ¼, ½, 1, 2-watters, carbon. 8 oz. 100% good.

BARREL KIT #104
SLIDE VOLUME CONTROLS
10 for $1.98
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SOCIAL EVENTS

Because of our publication schedule, all notices of social events must be received by the 15th of the third month preceding the event's occurrence. For example, a hamfest announcement for June 27th must be received by March 15th. Unfortunately, we cannot guarantee publication of notices received after this date.

ROCK FALLS IL
MAR 7

The Sterling Rock Falls Amateur Radio Society Hamfest will be held March 7, 1976 at Sterling High School Field House (bigger and better location), 1608 - 4th Avenue, Sterling IL 61081. Tickets $1.50 advance — $2.00 at door. For info write — Don VanSant WA9PBS, 1104 - 5th Avenue, Rock Falls IL 61071. Talk-in 94 simplex.

TOLEDO OH
MAR 13

The 21st Annual Ham Auction. America's Largest. Saturday, March 13, 1976, at Lucas County Recreation Center, Toledo, Ohio. Auction, flea market, commercial displays, prizes, XYL luncheon ($2.75 by 3/1/76). 8:00 am to 5:00 pm. $1.50 advance (SASE), $2.00 after March 1st. Talk-in 146.52. Toledo Mobile Radio Association, Box 273, Toledo, Ohio 43606.

BERRIEN SPRINGS MI
MAR 13

The Blossomland Amateur Radio Association's 10th annual hamfest will be held Saturday, March 13th, at the Berrien County Youth Fairgrounds, Berrien Springs. Advance registration $1.50; $2 at the gate. For info, write: BARA, PO Box 345, St. Joseph, Michigan 49085.

BELTSVILLE MD
MAR 14

The annual Maryland FM Association's Electronic Swapfest will be held on March 14, 1976 from 0830 to 1530 hours at High Point High School, 3600 Powder Mill Road, Beltsville, Maryland. Donations are $2.00 per person, and tables will be available for $3.00 per table. For advance tickets and/or reserved table send appropriate remittance to David McCrory WA3TKW/KQI2199, P.O. Box 111, College Park, Maryland 20740. Please make checks payable to the Maryland FM Association, Inc. Prize drawing will be held at 1500 hours. Talk-in will be on 146.16/146.76 MHz. Any correspondence with reference to the Swapfest should be directed to: David McCrory WA3TKW/KQI-2199, Chairman Electronic Swapfest, P.O. Box 111, College Park, Maryland 20740.

VERO BEACH FL
MAR 20-21

The Bi-Centennial Treasure Coast Hamfest will be held at the Vero Beach Community Center Saturday and Sunday, March 20 and 21, 1976. Sponsored by Vero Beach Amateur Radio Club, Inc., and St. Lucie Repeater Association, P.O. Box 3088, Vero Beach FL 32960.

EAST RUTHERFORD NJ
MAR 20

The Knight Raiders VHF Club's auction and flea market will be held on Saturday, March 20th, at St. Joseph's Church of East Rutherford, Hoboken Street, East Rutherford, New Jersey. Free admission, free parking, refreshments available. Talk-in on 146.52 and 146.94. Doors open at 11 am. Flea market tables: $5 for full table, $3 for a half table. Reserve your tables in advance by writing to The Knight Raiders VHF Club, Inc., K2DEL, P.O. Box 1054, Passaic, New Jersey 07055.

WASHINGTON DC
MAR 24

1976 ARRL Technical Symposium on Mobile Communications will be held on the evening of Wednesday, March 24, 1976 at the Statler Hilton Hotel, Washington, DC. Areas of interest are: HF/VHF/UHF mobile communications, repeater technology and operations, signaling and control techniques, special mobile communications (AMSAT, ATV, RTTY, etc.); especially subjects of interest to both amateur and commercial mobile radio users. Summaries are due by February 1, 1976. Manuscripts, photo of author and biographical sketch of amateur/electronic background due by March 1, 1976. Write: Paul Rinaldo K4YKB, 1524 Springvale Ave., McLean VA 22101 or call (703) 356-8918 evenings.

TOWSON MD
APR 4

The Greater Baltimore Hamboree will be held April 4, 1976 at 8 am at the Calvert Hall College, Goucher Blvd. and LaSalle Road, Towson MD 21204. (One mile south of exit 28, Beltway-Interstate 695). Food service, prizes, contests and a giant flea market. 250 tables inside gym. Registration $2. Over 1000 attended last year. Information: Contact Brother Gerald Malseed at school address or call 301-825-4266.

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